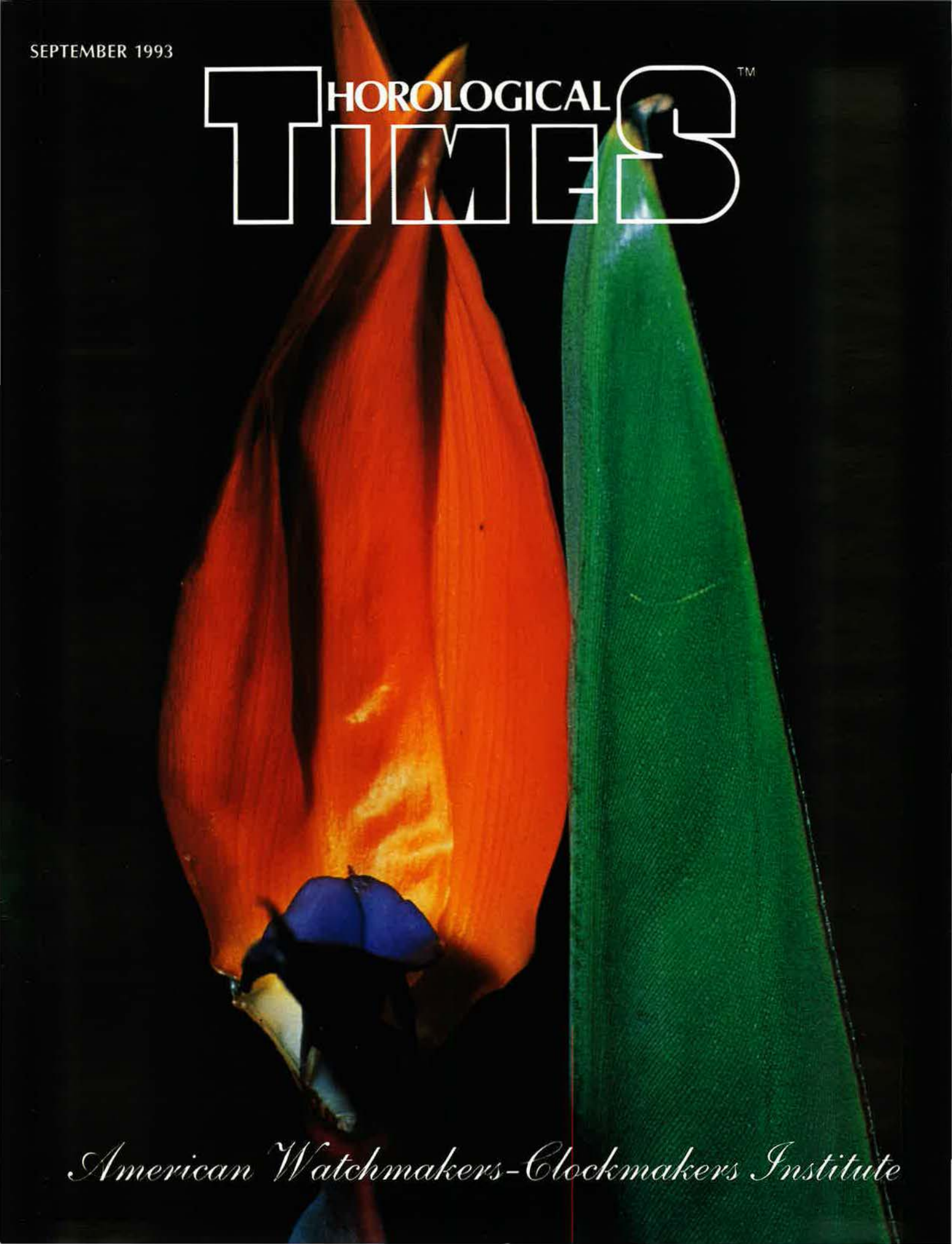
SEPTEMBER 1993

HOROLOGICAL TIMES™



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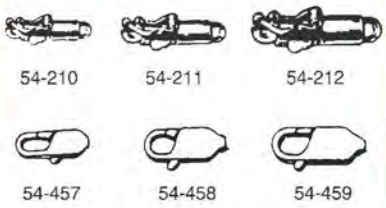
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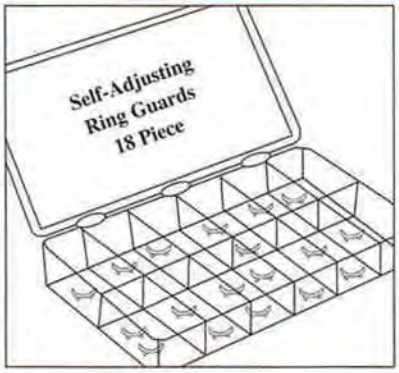
	54–210	54-211	54-212
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14KW	7.40	9.50	N/A

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Official Publication of the American Watchmakers-Clockmakers Institute

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EXECUTIVE AND EDITORIAL OFFICES

AWI Central
P.O. Box 11011
3700 Harrison Avenue
Cincinnati, OH 45211
Telephone: (513) 661-3838
Fax: (513) 661-3131
AWI Technical Hotline: (513) 661-4636

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President's Message



If I had a title for this article it probably would be "Let's See Us As Others Do." Maybe it's that unattractive box sitting in the corner of our shop that our customer can see. No, not us, we are so used to seeing it that we really don't even see that box anymore.

The box was just an example in a story I made up, but now for the real truth.

My bench is around the corner and therefore out of sight from our customers' viewing. The older I get, the neater by bench looks. I hate to drop a part in my apron and sort through 50 things to find it. In fact, I hate to have jobs stacked up in my apron, so I solved this problem. I have a box to the left of my bench which will hold all of those rush jobs that I need to do today, or at least sort out today. These jobs are the same as being on my bench or in my apron, but since they are off to the side I can do them one at a time. Actually I have not figured a way to use my two hands and do several jobs at the same time. This is not quite true, as we can start several jobs and then do various steps together, but this production method is another story.

I sort of shifted off of the subject, so to get back on track, let me tell you what our customers see when they look toward our repair shop area. They don't see my bench, but they do see another bench. This is an extra bench and is very visible to the customers' eyes. Being about 17 feet away from the customers' viewpoint, it looks messy. Well it did until last week. I stood on the customers' side of the showcase and took a peek. We were using this extra bench to pile up the day's mail (including packages) until we had time to sort it. Yes, it's clean now. The mail has been moved to the office area which is not visible to the customer. Please don't ask if this area is always clean. You and our customers will never know, it is out of sight now.

It is surprising how much our customers see and how it can affect them. Generally they will not say, "Your bench back there sure looks messy," but they may think it. If our shop or store or even our home looks nice, our customers will notice the difference. Case in point: Recently we had siding put on our house. It is hard to believe all of the people that see us somewhere (even in church) and say how nice our house looks now. The most startling part is we didn't know that so many people knew where we lived. Before we did this siding job, they certainly did not make a point of telling us that our house needed painting.

Yes, how our business looks to our customers is important. They may not tell us until we clean up our act.

Wes Door

ON THE FRONT: Bird of paradise by Mike Butterfield of Albuquerque, NM.

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Questions & Answers



HENRY B. FRIED
CMW, CMC, FAWI, FBHI, ★FNAWCC

A 19th Century German Clock Movement

Q I am enclosing photos of a clock movement about which I would like some information. Would you know who made it, and the approximate date of manufacture? Also, would you know how heavy the weights are?

I would greatly appreciate answers to these questions as well as any additional information you may have. A friend brought this movement to me and said he'd had it for a number of years, and now would like to make a case for it.

Aubrey E. Ward
Indianapolis, IN

A *From your photos, this movement appears to be German of the last quarter of the 19th century. The case may be the type that housed the German versions of the Viennese regulators.*

The length of the pendulum can be ascertained by counting the number of teeth in the center wheel X the number of teeth in the third wheel X the number of teeth in the escape wheel X two (the pallets). This is then divided by the number of leaves in the third wheel X the number leaves in the escape wheel. This will give you the number of beats (or swings) of the pendulum in one hour. From this number, one can then tell how long the pendulum can be.

Evidently, this is not a striking clock and the two weights are geared so that they both turn the eight-day wheel. When you know the length of the pendulum, then you can design a case to accommodate it.

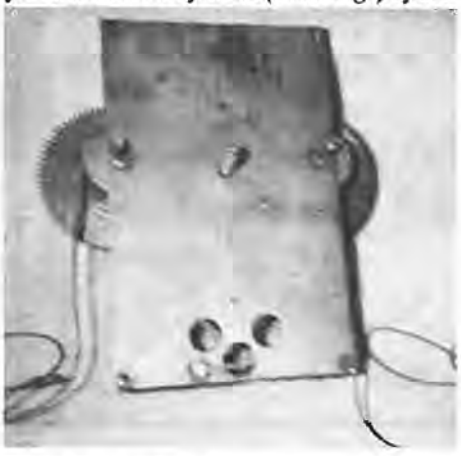
As for the weights, that can be discerned after the clock is kept going. A very heavy weight is suspended from a fish or laundry scale. The string from the pulley (temporary one) connects both weights as a loop to the scale long enough to have that weight reach the ground or some platform. Then wind up both drums of the weight wheels until the scale is reading its limit. This will run the clock until the spring of the scale is reduced until the clock stops. The scale will then tell you the lowest possible weight that will run the clock.

As for the pendulum and hanging it, that will be at first, a temporary thing as the suspension spring will have to be attached to the backboard of the unit holding the clock movement.

If you care to, send me the wheel counts as I have described above, and I'll give you the pendulum length and other details.

The anchor crotch and anchor appear to be that of a recoil escapement, and a rather long one. We'll answer that when you send more information. The movement doesn't show any screw holes where the suspension can be attached. Therefore, my guess is that it's held at the back of the case like some German types of Viennese clocks.

Henry B. Fried









Send your questions to:
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3/8
7/16
1/2
9/16
5/8
11/16
3/4
13/16
7/8

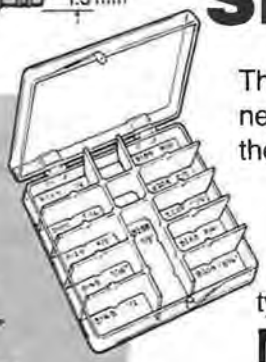
DOUBLE FLANGE
5/8
11/16
3/4
13/16
7/8

THIN 1.5mm
1/2
9/16
5/8
11/16
3/4
13/16
7/8

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5/8

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5/16
3/8
7/16
1/2
9/16
5/8
11/16
3/4
13/16
7/8

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ROCK QUARRY et tu

And How Was *Your* Vacation?



FRED S. BURCKHARDT

By now, all of you should have taken your vacations. If you haven't, there must be something wrong with you.

It's a great horological tradition to take a vacation every year. Even if you don't go anywhere, at least say you've been to some exotic place like Nice, the Bahamas, Tahiti, or South Street in Philadelphia.

Personally, I don't like to plan vacations. I'm the type who just likes to go and not worry about having to be in a certain place at a certain time because the reservations are already made. Maybe it's because I've worked with time for so many years that I like to forget about it once in awhile. On the other hand, my spouse is just the opposite. Everything must go according to blueprint. By the time we're ready to leave, either we're not speaking or my mouth is taped shut so I can't speak. Over the years we've had some serious disagreements about vacations. Not serious enough for divorce, but murder has been considered several times.

The worst thing you can do is go to a travel agency for advice. Let's face it, those travel brochures could make Alcatraz look good. Have you ever noticed the difference in the appearance of the actual place to its brochure picture? You'll find the best places are those not large enough to afford pictures in brochures. Usually they're not crowded and the people are much more pleasant than they are in the crowded locations.

Some feel they have to lie when asked where they went on vacation. For example, when asked, I reply, "The shore." This isn't to say *which* shore, as it could be the shore at the local lake. Other times, I say Athens or Paris, two towns in Texas. This is impressive, especially to those from out of town and not familiar with Texas towns.

Have you ever had a week off and tried to drive two thousand miles and back? Why do people do this? By the time you reach your destination and say hello, it's time to get back in the car and start the return trip! Don't try this if you have several small children. Stopping every mile and a half for the potty or to get a drink will slow you down quite a bit.

My favorites are those who have to travel to foreign countries for vacations. Now don't get me wrong; I've been to foreign places, courtesy of a rich uncle who paid for everything--even furnished all my clothing. But I'll still take the good old USA. Like one person who had just returned from a trip to Europe said to me, "Everything is so *old* over there!" After all, what places over there can compare to some of my favorite spots like Mandan, North Dakota; Tucumcari, New Mexico; Winnemucca, Nevada, or Pocahontas, Arkansas? These are places where you can spend a *real* vacation. Not crowded, plenty of hospitality, and they show a real appreciation for your business. If you hit Pocahontas at the right time, you may get to enter their "Spitting, Belching, or Cussing Contest." Tell me, where can you find this much excitement overseas?

There is one thing I would like to do, and that is to go on a cruise. Every time we plan on one, a show comes on TV about the *Titanic*, and I lose interest. I know the way ships are built nowadays; there's very little problem with them sinking. Some will stay afloat for almost five minutes.

Flying is a different matter. Like they used to tell us in the Air Force, if something should happen, don't worry; this plane is designed to glide down. Well, I'll let you in on a little secret: I've seen more than a few that must have had something wrong with their design, because they sure didn't glide down. In fact, they went down like rocks.

At least we were issued parachutes. Why don't they issue them in commercial airplanes? Think about that for awhile . . .

Anyway, what I'm trying to tell you is, every watchmaker and clockmaker should take a vacation at least once a year. Twice is better. Three times or more is great.

If it were up to me, I'd work two weeks and take the rest of the year off!

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News in the Trade

AWI AT NAWCC NATIONAL

AWI held one of its bench courses in conjunction with the NAWCC National held in Dallas, TX. The course was taught the three days before the actual convention but simultaneously with other educational classes. Eight students participated in the "Basic Watch Repair" class. This course covered replacing balance staffs and setting up the Swiss lever escapement.



AWI Instructor Jim Lubic (center) prepares to check the work of Charles Hahn.

JOHN W. H. RYAN APPOINTED VP/MANAGER OF BULOVA'S CLOCK DIVISION

John W. H. Ryan has been appointed Vice President and Genrral Manager of the Bulova Clock Division, as announced by Paul Sayegh, Chief Operating Officer, Bulova Corporation.

In his new position, Mr. Ryan will direct and oversee the Sales, Marketing, Merchansiding and Inventory Control functions of the Clock Division.

Mr. Ryan comes to Bulova with a strong background in clock sales and marketing. Prior to joining Bulova, he was Senior General Manager of National Accounts for Watches and Clocks at Seiko Time Corporation. During his 12-year tenure at Seiko, Mr. Ryan also served as General Manager of their Clock Department.



John W.H. Ryan

"We are pleased to name John Ryan to this important position, and feel that he has the proven management, marketing, and selling experience necessary to help Bulova to continue to grow its clock sales and maintain its leadership position in the clock marketplace," said Mr. Sayegh.

WINNERS OF ESSLINGER'S DRAWING AT JEWWELRY '93

The winners of a drawing held by Esslinger & Co. at the Jewelry '93 Show in Las Vegas were Joan and Jim Ricotta of Ricotta Jewelry in Philipsburg, PA. Ralph Crivelli, representing Esslinger & Co., presented the prize--a Jewelry PhotoMaster.

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For more information, call **(919) 756-9290** and ask for David Edwards, or log-on at **(919) 321-4069** to try it.

JA'S PROMOTION CONTEST FOR "REAL JEWELRY MONTH"

Jewelers of America (JA) and *National Jeweler* are once again co-sponsoring a competition for the best Real Jewelry Month in-store promotion. Judges will be looking for promotions that are original, incorporate a series of events, and include an educational flair, like last year's winner--Rose and Dan Kirk, Kirk & Co., Batesville, IN.

What made the Kirk's Real Jewelry Month promotion a winner to the judges was that it was a month-long series of events. It used advertising and in-store displays. It made the most of promotional materials provided by JA. And, most importantly, it focused on an educational event rather than bombarding customers with an ordinary sales promotion. The idea of educating the public about buying fine jewelry is the motivation behind Real Jewelry Month.

Those interested in entering will need to send a written description of their promotion, along with documentation (advertising, local media responses, etc.) to: **National Jeweler, 1515 Broadway, New York, NY 10036.** The deadline is January 3, 1994. The winner will receive an award and be featured in upcoming issues of *National Jeweler* and the *JReport*, the JA monthly member newsletter.

For more information, contact JA's Communications Department at **1185 Avenue of the Americas, 30th Floor, New York, NY 10036; (212) 768-8777.**

UPCOMING JEWELRY SHOW TO BE HELD IN ATLANTA

The Great Southern Gem & Jewelry Show is coming to the North Atlanta Trade Center, November 5-7, 1993. Covering 100,000 square feet of exhibit space with gems and fine jewelry from around the world, it will be the largest public show of its kind in the Southeast.

Just in time for holiday gift buying, attendees can see and shop over 500 exhibits of quality jewelry including necklaces, rings, pins, bracelets, precious and semi-precious stones. Wholesale/Trade Day on Friday (November 5) from 11 am to 7 pm. Public days are Saturday and Sunday, 10 am to 6 pm. Admission is $5.00 for adults, $4.00 for seniors, and free for children under 12.

For more information call **(404) 279-9899.**



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Taking the pulse

"I don't know what your destiny will be, but one thing I know, the only ones among you who will be really happy are those who have sought and found how to serve—

ALBERT SCHWEITZER

Pat Madden's special area of service contributes much to her personal happiness. Three years ago her love of the theater, coupled with a desire to be active and make new friends, led her to volunteer to take part in an effort to revitalize Cleveland's downtown theater district.

As a "Playhouse Square Volunteer", Pat frequently devotes more than 60 hours a month during the busy season working as a tour greeter, usher and planner of special events. She was recently honored for her efforts with The Mayor's Award For Volunteerism.

Pat has been with Eveready® for 17 years. When she isn't at work or doing duty at Playhouse Square, she likes to travel. She has been to Europe three times, Australia once and to countless places in the U.S.



Pat Madden's second floor workplace has an interesting history. Before it became the property of Eveready® it was a showroom for new Hupmobile automobiles (circa 1930). Today its ornate columns and moldings are home to row upon row of "computer controlled test cabinets" which hold *thousands* of miniature batteries of every conceivable size and type.

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ETA UNVEILS WORLD'S FLATTEST 8-3/4''' MASS-PRODUCED MOVEMENT

Europe's largest manufacturer of watch movements and components, ETA SA Fabriques d'Ebauches (Grenchen, Switzerland), a company belonging to the SMH (Swiss Corporation for Microelectronic and Watchmaking Industries, Ltd.) group, recently unveiled a brand new 8-3/4''' automatic mechanical movement. Designed expressly to satisfy requests from ETA's customers, this new movement will be flatter than any other movement of its size to be mass-produced anywhere in the world.

The new movement displays the hours, minutes, and seconds with hands and the date in a window. These are controlled by a 3-position stem. In the first or running position, the movement can be wound manually if it has stopped during storage. In the second position, the stem enables the user to rapidly correct the date, and, in the third position, to synchronize the time display exactly with a time signal using the stop second device. The automatic mechanism provides a power reserve of at least 42 hours.

During the development stage of this addition to its Mecaline range of mechanical movements, the company's engineers gave priority to using components and systems which had proved particularly efficient and reliable in other ETA calibres. At the same time they exercised considerable ingenuity when it came to fitting an automatic winding mechanism into the small space available. The latter resulted from the need to limit the overall height to no more than 3.60 mm to meet customers' demands for a very flat movement.

ETA's new 8-3/4''' automatic movement (calibre 2000) is expected to generate great enthusiasm among the producers of high-class mechanical watches for which there has been such a striking revival in demand in recent years.

For more information, contact **François Habersaat, ETA SA Fabriques d'Ebauches, CH-2540, Grenchen, Switzerland; tel. (065) 51 71 71; fax (065) 51 71 74.**



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SCHOLASTICALLY SPEAKING

North Seattle Community College

Tony Knorr, Instructor

Students in the Watch and Clock Technology program at North Seattle Community College are often in awe of the view. On a clear day outside of the classroom on the west side of the urban campus, the view is of the pristine Cascade Mountains framing the city's homes, traffic, and shopping malls.

Inside the classroom, the view is of the inner workings of watches and clocks--the result of a state-of-the-art video camera which magnifies intricate repairs and alignment techniques to the entire class using an overhead monitor. Students can see even the finest details of the day's lesson.

The view of the student's future after completing the specialized program may be even better.

A promising career, beautiful surroundings, and outstanding instruction and facilities are just a few of the reasons students choose to enroll in the outstanding program at North Seattle Community College. One of four campuses in the Seattle Community College District (Seattle Central, South Seattle Community Colleges, and Seattle Vocational Institute are the others), North is the only one among them to offer a horology program.

Students may earn a vocational certificate after completing 102 credits which takes about two years. Classes include a sequence of courses in Watch and Clock Technology and specially designated classes in Jewelry Design. To earn an Associate of Applied Science degree, students must also complete selected English, Business, and Engineering courses. Training is provided in lathe work, filing, grinding, tool making, gear cutting, theory and adjustment of the escapement, parts manufacturing, hairspring manipulation, and cleaning and adjusting all types of watches and clocks.

One step inside the classroom, and even the layperson can see the emphasis on lab work. The room is a collection of benches, each one equipped with hand tools and a good work light. Students are either intently bent over their work or studying the details on the screen above. The room has a reverent silence. Visitors from the community who bring in their watches and clocks for repair and use as laboratory study pieces, often feel compelled to speak in whispers and tip-toe out, closing the door quietly behind them so as not to disturb the class work.

The work they bring in gives students the opportunity to repair everything from antique timepieces to clocks and modern quartz watches. The fee is the cost of the parts only. It gives students the chance to work directly with customers, which is also likely to be part of their real world experience.

Besides these hands-on experiences in the main classroom, students learn about lathes and milling machines to fabricate tools, parts, and cut gears in a special adjacent laboratory.

The program has been part of North's curriculum since the college's inception in 1970. Tony Knorr, with 44 years of experience in watch repair, has been in charge since 1989 and has never stopped improving program curriculum and facilities. He continues the school's historic commitment to the program which was developed by long-time instructor George Lewis.

Lewis was a talented gymnast and coach of the 1964 Olympic gymnastic team. He put an athlete's zeal into his teaching, acting as a trainer and coach for watch and clock technology students at North from 1970 until his retirement in 1988. This year a commemorative sundial was placed in the campus iris garden in his honor.

Knorr maintains Lewis' enthusiastic tradition with help from Lynne Hull, an artist who specializes in metal work and jewelry. Hull inspires her students on how to combine craftsmanship with creativity in design, fabrication, stone setting and cutting, tool usage, soldering, chainmaking, casting, and a wide range of jewelry making techniques. This combination of horology and jewelry exposes students to useful and creative skills.

Knorr keeps track of his alumni. He has found them everywhere from downtown jewelry shops to Switzerland where some students have continued their studies. Virtually all graduates who want to work in the field find employment, usually in watch service factory

(Please turn to page 41)

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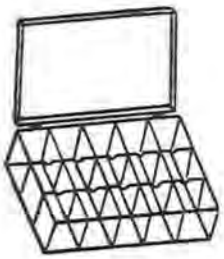
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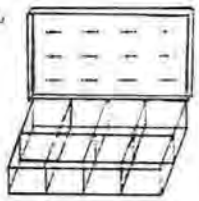
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Part LXXXXIII

Making a Double-Duplex Escape Wheel



ARCHIE B. PERKINS
CMW, FNAWCC, CMBHI
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The double-duplex escapement was used in watches made for the Chinese trade in the middle 1800s. These watches were known as Chinese duplex watches; therefore, the escapement is often referred to as a Chinese duplex escapement. This escapement is also referred to as a crab-tooth escapement because the teeth resemble a crab's claw.

This escape wheel is more difficult to make than the single duplex escape wheel. There are three reasons this is true. The wheel is made of steel instead of brass, more operations are needed to make the double-duplex wheel, and the wheel needs to be hardened and tempered after it has been made (whereas a brass wheel does not). The double-duplex escape wheel is made of steel so the teeth will be stronger and more wear-resistant. Steel is more difficult to machine than is brass.

Figure 1 shows a scale drawing of a double-duplex escape wheel. This drawing was made from a good escape wheel at a scale of ten to one. The angular measurements were gotten by chucking the wheel true in the lathe headstock and using a 360 index on the lathe spindle with an index latch fastened to the lathe bed. A circle saw that ran true on an arbor chuck was fastened in the milling head spindle and used as an indicator for checking the angular distances. Since there are 360 degrees in a circle, each division of the 360 division index plate equals one degree. The same index plate was used when making the new escape wheel.

Setting Up the Equipment

Figure 2 shows the arrangement used to make the escape wheel. The escape wheel blank is made and shellacked true to the flat end of a cement brass as shown. Enough shellac should be used to hold the blank securely to the face of the cement brass. The diameter of the cement brass should be the same as the diameter of the wheel blank. The wheel blank should be slightly too

Figure 1

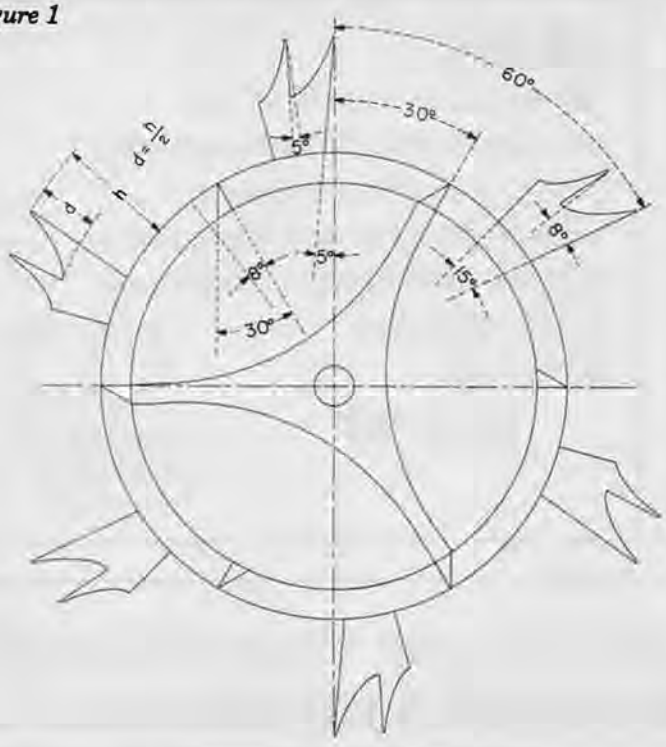
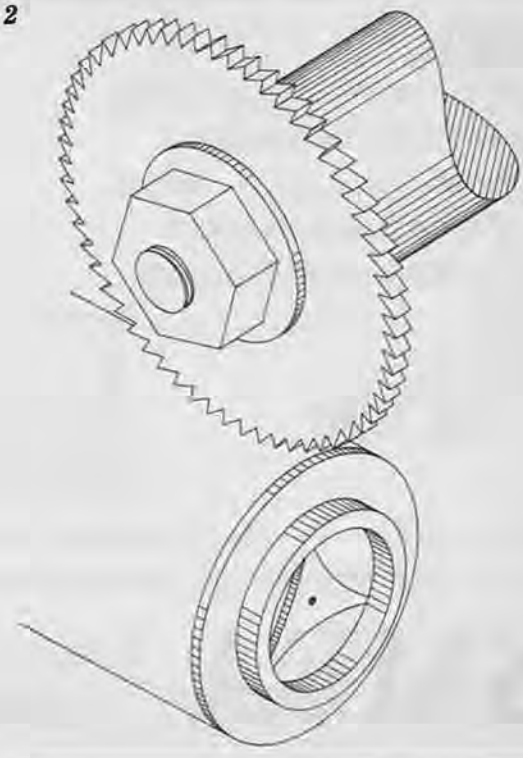


Figure 2



large to allow it to be trued up with a cutter after the blank has been shellacked to the cement brass.

The cutter for cutting the escape wheel is a fine tooth circle saw type cutter. The pitch of the teeth on the cutter should be about .50mm for best results. It would be best if both sides of the cutter were relieved so the cutting edge of the cutter would be thicker than the sides of the cutter back of the cutting edge. One can do the cutting of the wheel without relieving the sides of the cutter by being cautious. The diameter of the cutter used was 23.50mm with a thickness of .60mm. The thickness of the cutter can be greater than this for a double-duplex escape wheel, but it is not necessary.

Another requirement for the equipment is that the longitudinal slide of the slide rest holding the milling head has an adjustable stop. There should also be an adjustable stop on the vertical slide of the milling head. The reason for these stops is so the cutter can be fed to the same point each time it is moved. An adjustable stop is not needed on the cross slide of the slide rest.

Before one starts to cut the teeth on the escape wheel blank, the outside edge of the cutter should be centered up with the lathe headstock center as shown in Figure 3. Then, the center chuck is removed and the cement brass holding the escape wheel blank is fastened in the lathe headstock spindle.

Next, the escape wheel blank is turned true and to the correct diameter. Then the index latch is engaged in the index position of the index plate. This position should be marked with a line and an "0" at the end of the line. The marking can be done with a felt-tipped pen. This is an important position since it will be referred to several times while making the escape wheel.

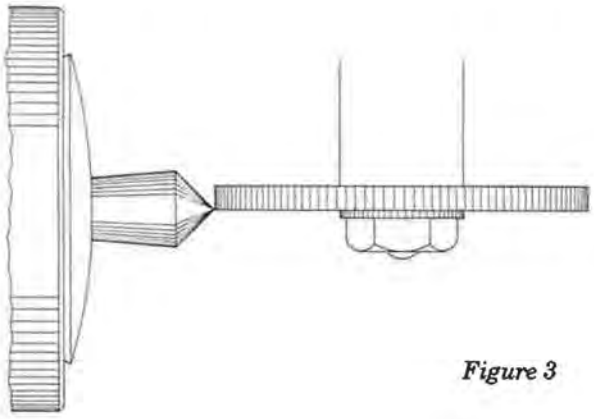


Figure 3

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Figure 4

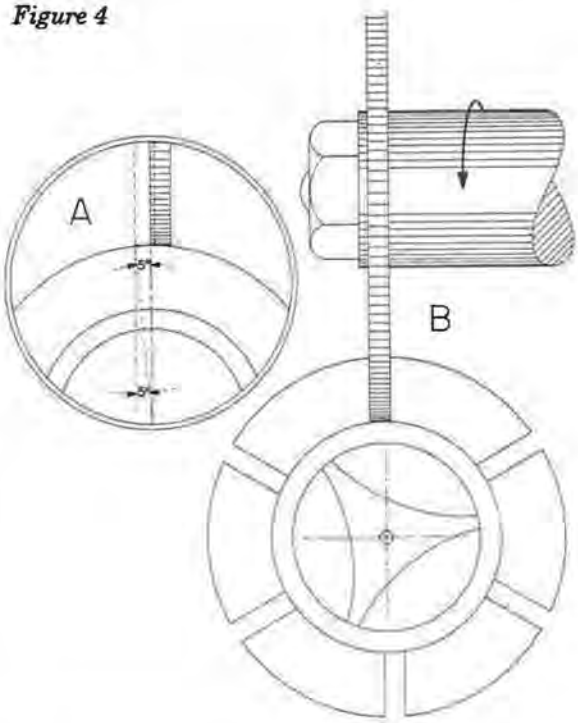
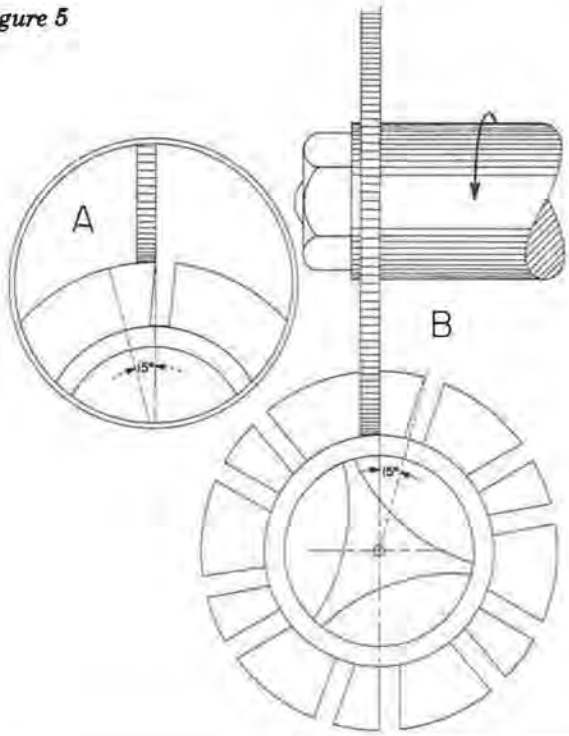


Figure 5



Cutting the Escape Wheel
Locking Tooth Sections

The first slot made in the escape wheel blank will form the locking faces for the locking teeth. On this particular wheel, the locking faces are undercut 5°; therefore, the centered edge of the cutter must be moved off-center 5°. Figure 4, View A shows how this is done. One would lower the cutter until its edge touches slightly on the edge of the wheel blank. Then, the cutter is turned by hand so a small mark is made by the corner of the cutter on the edge of the blank. The cutter is then raised from the blank. Next, the blank is indexed 5 divisions (5°) counterclockwise as shown. This index position is marked with the felt-tipped pen. Now, the cutter is moved over until its left corner is at the mark made previously on the edge of the blank. This new position of the cutter is shown in dashed line.

Next, the six slots are cut which will form the undercut locking faces of the locking teeth. These slots are cut to a depth which is almost to but not touching the impulse tooth rim of the wheel blank. When the proper depth has been reached, the stop on the vertical slide is set so all of the slots will be cut to the same depth. The wheel blank is indexed 60 notches or holes each time a slot is cut. These index positions should be marked as they are counted off.

After the first six slots have been cut, one would reset the cutter for cutting the slots which will form the back sides of the locking tooth sections of the escape wheel. This is shown in Figure 5.

View A, Figure 5 shows how to reset the cutter. With the index latch set in the "0" or starting position of the index plate, one would line up the right side of the cutter with the locking corner of the locking face of the slot as shown. Since the width of the tooth section will be 15°, one would index the blank clockwise 15 divisions. When the 15 divisions have been counted off, this point should be marked with a different color felt-tipped pen. This places the blank in position for cutting the backs of the tooth sections.

View B, Figure 5 shows the slots being cut. These are cut to the same depth as the first six slots. One would index 60 divisions each time a slot is cut. These new positions should be marked.

After the slots have been cut to form the six tooth sections, the excess material between the tooth sections must be removed with the cutter. This is shown being done in Figure 6. The dashed lines show the different positions that the blank is indexed to when removing the excess material. One can remove the excess material from each section individually or by removing the same amount from each section until all of the excess material has been removed. After the excess material has been removed from a section, the index latch is lifted from the index plate to allow one to move the headstock back and forth so the cutter will finish the rim of the wheel between the tooth sections. The headstock should be turned slowly back and forth to obtain a smooth finish. As the bottoms of the spaces are being smoothed out with the cutter, the cutter should be centered with the edge of the wheel blank.

Cutting the Escape Wheel
Locking Teeth

Now that the six locking tooth sections have been made, the double teeth are made on each section. The cutter

Figure 6

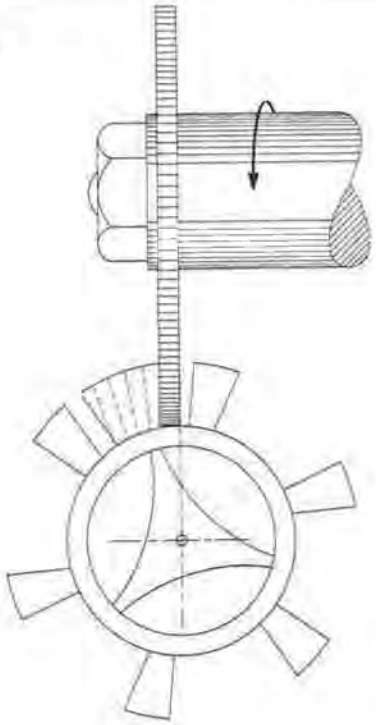
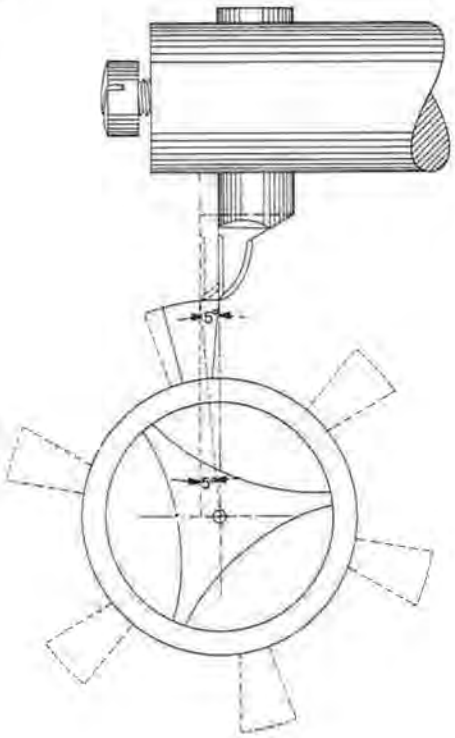


Figure 7



used for this job would need to be made up special. Since this escape wheel is made of steel, it would be best to have a fine tooth circular cutter to use for cutting the teeth. One could make a fine tooth circular cutter by using a pantograph device such as is shown in the December 1980 issue of *Horological Times* "Technically Watches" column.

The double teeth can also be cut with a proper fly cutter as shown in Figures 7 and 8. The fly cutter should be hard enough and tough enough to withstand

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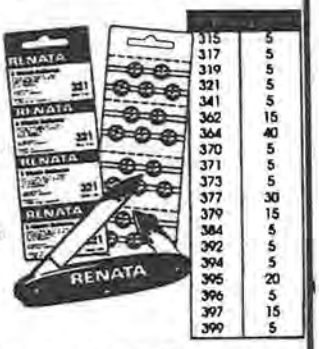
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Figure 8

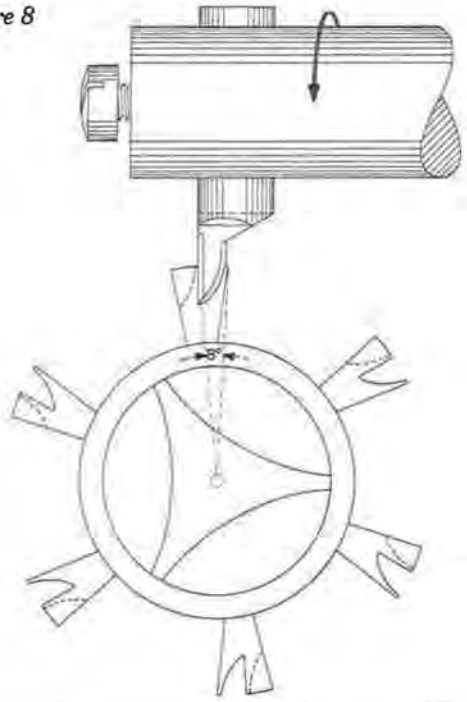
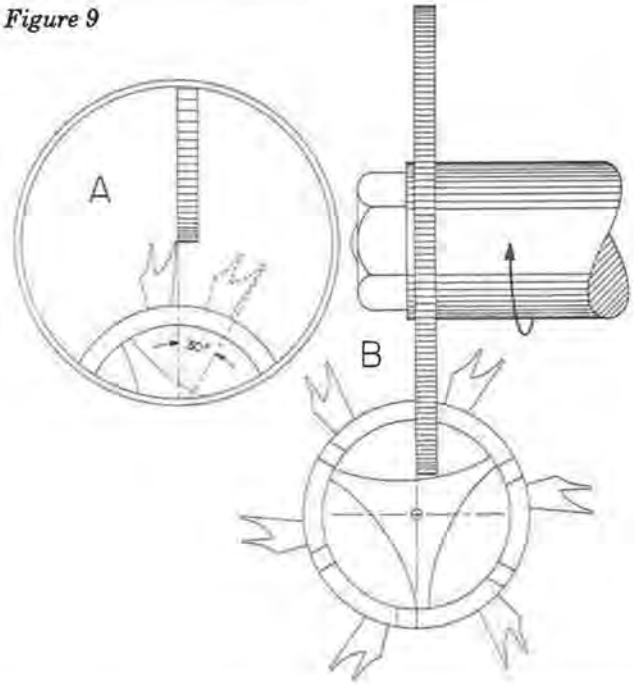


Figure 9



the cutting of the teeth without wearing down or breaking. The cutter should not be turned very fast and should be fed through the wheel blank very slowly and steadily. One should also take very light cuts all around the blank instead of trying to remove all of the material in one cut. If the fly cutter is made from carbon steel, it should be left hard. A fly cutter could be made from a high speed steel drill blank, or even a carbide drill blank for better results. The fly cutter shown in Figures 7 and 8 is held in a cross hole of an arbor chuck. The back side of the cutter is shown in the illustrations.

To set the cutter, refer to Figure 7.

First, the index is set at the "0" starting point. Then, the straight edge of the cutter is lined up with the locking corner of the locking face of the tooth section as shown. Now, the wheel blank is indexed 5 divisions (5°). Next, the cutter is moved off-center so the straight side of the cutter again lines up with the corner of the locking face of the tooth section. This is shown in dashed line in Figure 7. The purpose of setting the cutter 5° off-center is so the back tooth will be undercut 5° when the teeth are cut.

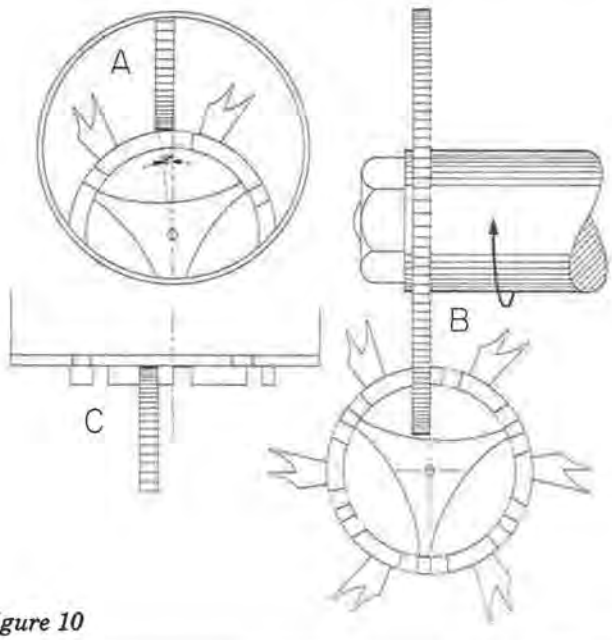


Figure 10

After the cutter has been set in its proper position, one would proceed to cut the teeth. This is shown being done in Figure 8. One would first index the blank clockwise 8 divisions, or 8°. Then, lower the cutter into the edge of the blank so it will take a very light cut. The same depth cut is taken on all of the tooth sections. Then the cutter is lowered slightly more as cuts are made again in all tooth sections. This is continued until the spaces are cut, leaving a flat tip on the teeth which has a width of about .08mm. NOTE: The teeth should not be cut so they have a sharp tip. This makes the tips of the teeth too weak and fragile.

Next, one would index the blank clockwise 8 more divisions and cut the back teeth on the tooth sections. When cutting the back teeth, there is less strain on the cutter, so these cuts can be made at full cutter depth by feeding the cutter very slowly. These cuts are shown in dashed line in Figure 8. One would index 60 divisions each time, and these divisions should be marked each time they are counted off.

Cutting the Faces of the Impulse Teeth

Next, the arbor chuck and its fly cutter are removed from the milling head, and the cutter used previously is placed in the milling head in preparation for cutting the impulse teeth. When cutting the impulse teeth, the cutter should turn in the opposite direction to the

direction used when cutting the locking teeth; therefore, the cutter should be reversed on the arbor chuck.

Figure 9 shows the start of this procedure. View A shows how the cutter is relocated to the proper position for the first cuts. First, the index latch is placed in the "0" starting position. Then, the left side of the cutter is lined up with the locking corner of the front tooth as shown. Next, the headstock is indexed 30 notches (30°) clockwise which places the wheel in the proper position to cut a notch that will form the acting face of an impulse tooth. NOTE: The acting faces of the impulse teeth are situated exactly in the center between the tips of two front locking teeth. Since the tips of the front locking teeth are 60° apart, the acting faces of the impulse teeth would be 30° from these points. After the cutter has been positioned, the notches are cut. This is shown in View B, Figure 9. When cutting the impulse teeth, the cutter should turn in the direction of the arrow in View B, Figure 9. The cutter is fed through the impulse rim just to the point where the cutter stops making a cutting noise, then the stop is set on the vertical slide. With the slide against the stop, the cutter is fed into the impulse rim until the cutter is just short of touching the bottom of the cut-out of the blank. Then, the stop is set on the longitudinal slide.

After the first slot has been cut and both stops set, the other five slots can be cut by raising and lowering the cutter or by moving the cutter in and out of the impulse rim (View C, Figure 10).

Cutting the Width of the Lands for the Impulse Teeth

Figure 10 shows how the cutter is set and the width of the lands for the impulse teeth are cut. View A shows how the cutter is reset to cut the width of the lands. This time, the right side of the cutter is lined up with the acting face side of the slot as shown. Then the wheel is indexed 8 notches, or 8°, which places the wheel in position to cut the slot that will form the width of the impulse tooth land at 8°. NOTE: In some cases where the impulse tooth rim is very narrow, one may only need to index 6 notches in order to have enough width for the lands. View B, Figure 10 shows the 6 slots being cut, and View C shows a top view of a slot being cut. These slots are cut to the same depth as the first slots.

After the six slots have been cut, the excess material is removed from between the impulse teeth. This is done in the same manner as when the excess material was removed from between the locking teeth.

Cutting the Angle on the Backs of the Impulse Teeth

Figure 11 shows how the cutter is positioned and the angle is cut on the backs of the impulse teeth. To position the cutter, index the spindle holding the wheel blank 30 divisions (30°) counterclockwise. Then move the cutter off-center until the right edge of the cutter is in position to cut the back of the impulse tooth land to finish forming the impulse tooth. This is shown in dashed line

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in View A, Figure 11. It is a good idea to first move the cutter farther from center than needed, then remove material gradually from the back of the tooth until the tooth is correct. Then, the wheel is indexed and the backs of the other five teeth are cut. The outside corner of the impulse teeth should not be pointed but should be left with a flat surface which is .04mm to .05mm wide. This corner should be rounded and finished after the wheel has been hardened and tempered.

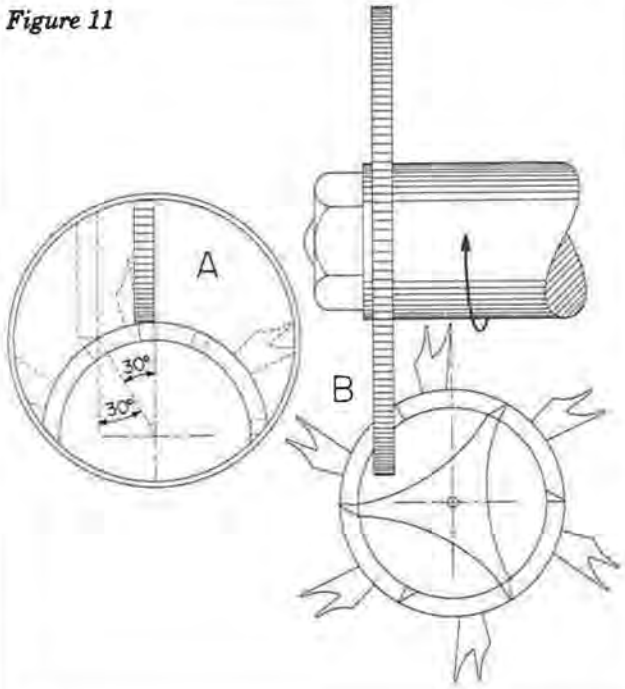
After the wheel has been completely cut, it is removed from the cement brass. The shellac is removed from the wheel and the wheel is hardened and tempered.

Hardening and Tempering the Escape Wheel

To harden the wheel, it is clamped between two discs of steel, one of which has been turned out to clear the impulse teeth of the wheel. The clamp can be a pair of tongs or the two discs holding the escape wheel can be held together with iron binding wire. The whole mass is first warmed and then dipped in boric acid powder so it is coated with the powder. Then, the mass is re-heated to a full medium cherry red and quenched in cold tap water.

Then, the wheel is removed from between the two discs and checked with a fine file for hardness. Then it is cleaned and tempered to a first blue color on some sand in a blueing pan.

Figure 11



"Antique Watch Restoration" will continue next month.

❑

BULLETIN BOARD

A. NEW REQUESTS

LARGE BALANCE WHEELS WITH STAFFS
Lathe classes, traveling and at Project Extend, need large balance wheels with good staffs for use in learning how to properly use the Jacot tool.

HAIRSPRINGS, COLLETS & STUDS
Several Project Extend courses and the traveling Bench Course on hairspring vibrating need all sizes of hairsprings, individual collets, and studs.

COMPLICATED WATCHES FOR PRACTICE
The course on complicated watches seeks mechanical movements for student work. Partial movements will be put to good use.

B. RESPONSES

PLANS TO BUILD WOODEN WORKS GRANDFATHER CLOCK
Several readers pointed out that S. LaRose sells plan #087089 for $7.95. Ivan Sumeardl, Plainville, KS and Wallace Morse, Puluth, MN supplied copies of plans by John R. Lord which appeared in *Fine Woodworking*, Spring 1978. We also received plans for an 8-day movement by James Darron.

HAHL MFG. CO.--PNEUMATIC MASTER CLOCK
Alton A. DuBois, Jr., Queenbury, NY, suggests that copies of Hahl patents should be available, and the firm named below buys and sells parts for Hahl clocks.

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HENRICHS JEWELRY CO.
Jewel J. Bonat, Hamilton, KS, writes:

This clock hung in the window of Virgil Henrichs Jewelry at 139 North Main in Wichita, KS back in 1929. I was a jewelry delivery boy for the L&W Wholesale Jewelry at the time.

C. ITEMS STILL NEEDED

BRANSON MODEL 52 SCHEMATIC
Richard Diefenbach, St. Johnsburg, VT, is aware that AWI has a number of schematics for Branson cleaners. Unfortunately, we do not have a sche-matic for Model 52. If you can supply, we will add it to our collection which consists of schematics for B-12, B-12R, B-12S, B-220, B-220R, and B-32.

ULLMAN ELECTRIC CLOCKS
Martin Sarill, St. Petersburg, FL, is seeking the distributor of Ullman Electric Clocks which he says are Swiss made.

Do you have information regarding this month's requests? Do you need information about one of this month's responses? If so, send a self-addressed, stamped business-size envelope and your request to: "Bulletin Board," c/o AWI Central, 3700 Harrison Avenue, Cincinnati, OH 45211.

AWI AWARDS SCHOLARSHIPS

AWI has awarded two scholarships to the winners of the "It's About Time" division of the National Science Olympiad.

The winners this year were Josh Horstman and Eric Baldwin of North Central High School in Indianapolis, Indiana. They designed and made a meter length pendulum with an indicator scale.

The finals were held at the University of Southern Colorado at Pueblo. Forty-nine teams, consisting of 98 high school students, competed in this event.

According to Wes Door, President of AWI, "We like to encourage these youngsters, as many of them have expressed an interest in entering the watchmaking and clockmaking professions."

Jerry M. Faier represented AWI, and is also involved with the Science Olympiad. If you would like to become involved or would like more inforrmation, contact: **Jerry M. Faier, The Clock Makers, 7210 W. 79th Street, Overland Park, KS 66204; (913) 648-2014.**

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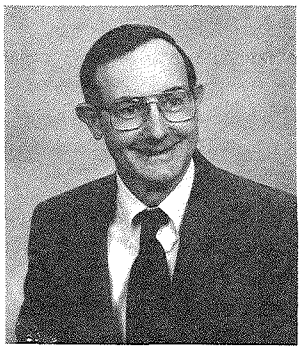
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WATCHES Inside & Out!



ROBERT D. PORTER, CMW

How to Make a Stopworks Star Wheel

Figure 1 illustrates a condition we find quite often while servicing high-grade watches. The star wheel (also known as a Maltese cross) component of the counting and locking mechanism usually mounted on the mainspring barrel cover is missing. Possibly, it was removed to increase the running time of the watch at the expense of accuracy. Five or six full turns of mainspring torque can usually be stored in the barrel without the stopworks. The star wheel mechanism most often seen will allow four turns of the most uniform portion of the mainspring torque to be used, thereby improving the timekeeping of the watch by assuring that the gear train and balance wheel receive a more constant flow of power from the mainspring.

Figure 2 is the result of an experiment with an 18 size mainspring barrel to see how much the relative torque increases per turn as the mainspring is wound. An orphaned barrel was used for the experiment. A lightweight aluminum moment arm with an effective length of about 1.5 inches was epoxied to the barrel cover. The barrel arbor was chucked in the lathe with the moment arm in an upright position. An elastic band was attached to the moment arm at the 1.5 inch position, and the elongation of the elastic band measured at each full revolution of the mainspring as it was wound. The graph shown in Figure 2 is a best fit average of several recordings, and appears to follow Robert Hooke's Law (as is the tension, so is the force) up to about the 4th turn before the torque in this particular barrel increases considerably during the last two turns.

The star wheel looks rather complicated, but it is a lot of fun to make. A milling attachment for our lathe and a means of dividing the circle into ten equal segments is required.

Figure 3 shows a typical stopworks assembly in the lock-down position. The arrows represent important measurements that must be determined before starting to make the star wheel.

As the watch is wound, the action of the finger piece and star wheel is illustrated in Figures 4 and 5. This action continues for four turns until lock-up occurs, as shown in Figure 6.

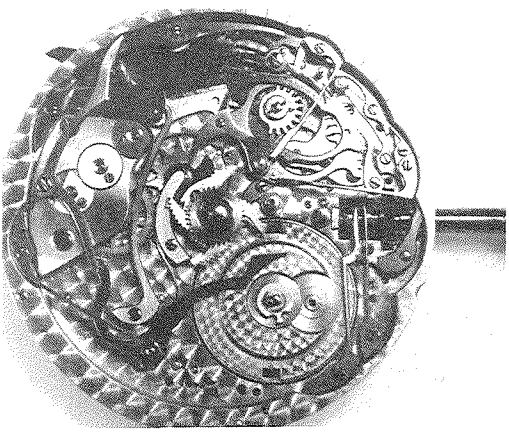


Figure 1

Figure 2

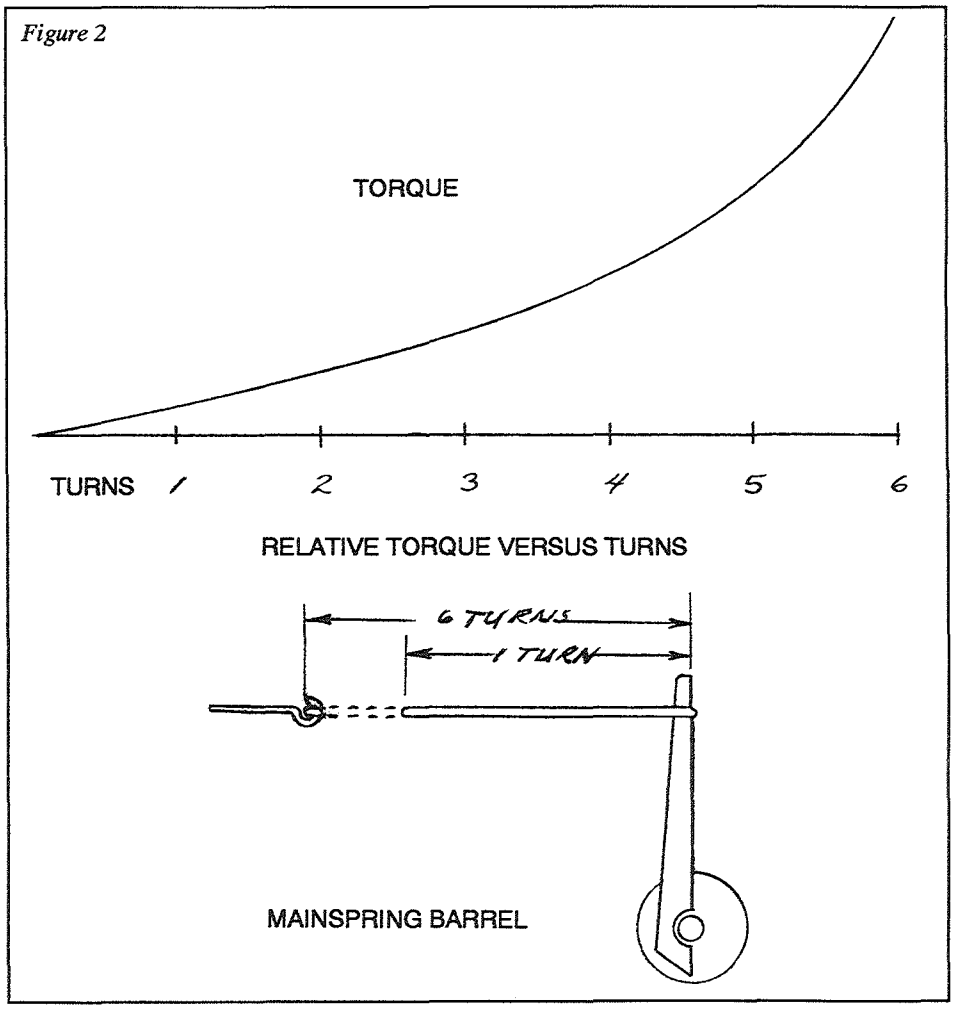
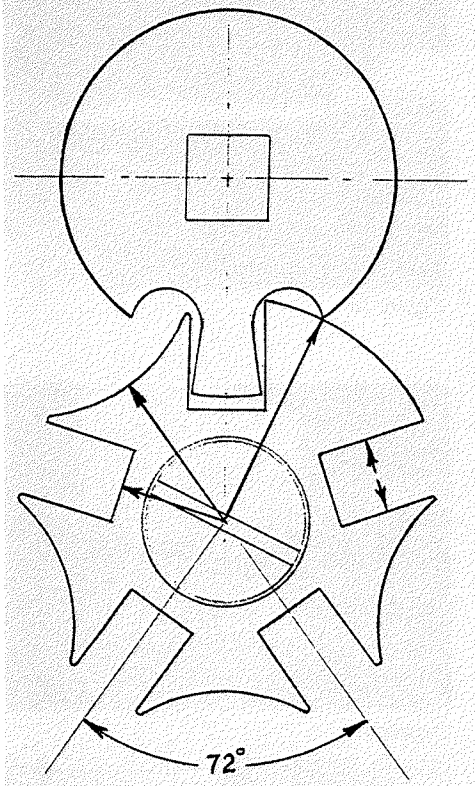


Figure 3



STARTING, LOCK-DOWN POSITION

Figure 4

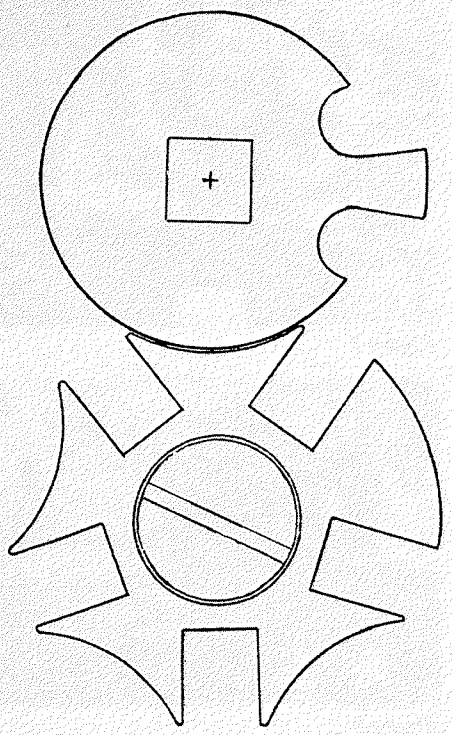


Figure 5

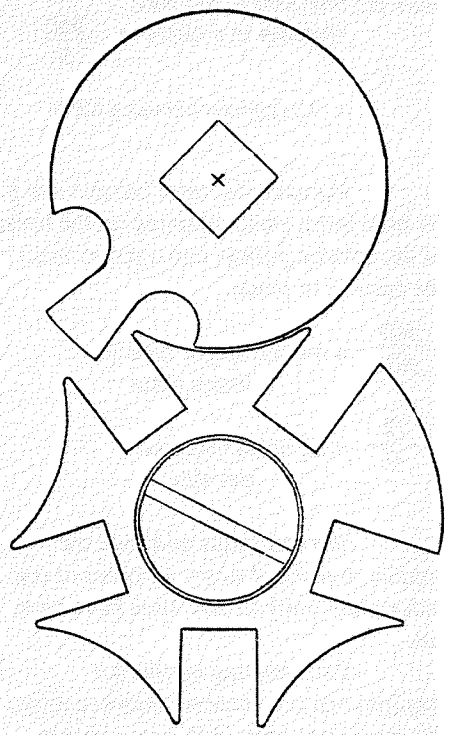
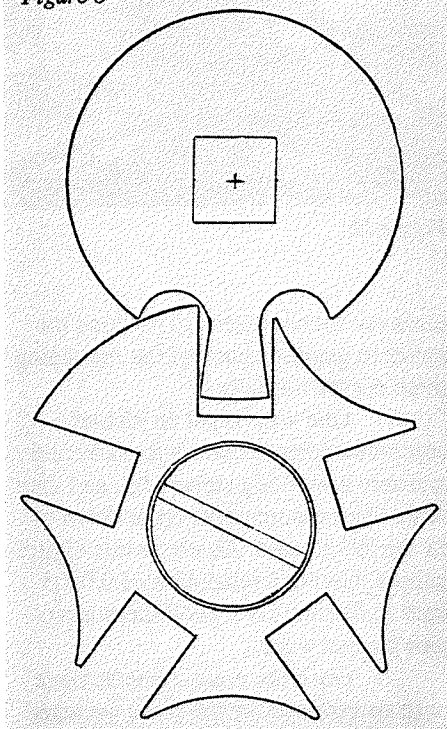
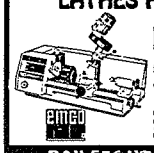


Figure 6



LOCK-UP POSITION

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Five equally spaced passing slots are required in the part:

Degrees in a circle = $\frac{360}{5}$

= 72 degrees between slots

Fortunately, most lathes have a 60-hole index plate mounted on the back of the spindle pulley, and a pin to lock the spindle in place.

$\frac{360}{60}$ = 6 degrees per hole in index plate

$\frac{72}{6}$ = 12 holes required per slot

We can rotate and lock the spindle in place at every 12 holes of the index plate until all five slots have been cut.

Four passing curves are required and are centered between slots. We must then index 6 holes to center the milling cutter between slots and then cut the first curved surface. Then index 12 holes between each of the remaining three curved surfaces. The milling cutter used to generate the curves must be nearly the same diameter as the finger piece.

A good source of information for those of you who may be interested in making an indexing attachment for your lathe is the book *The Watchmaker's Lathe* by Ward Goodrich (available from the AWI Library, or from most horological book dealers). The April 1982 issue of *Horological Times* also contains a very useful article, beginning on page 16, by Mr. Archie Perkins on indexing attachments for the watchmaker's lathe.

Figures 7 and 8 illustrate my 30-year-old homemade indexing attachment, which consists of a 32-pitch, 120-tooth, bronze worm wheel mounted on the lathe spindle and driven by a matching single start ground and polished worm. The worm and wheel were purchased from the Chicago Gear Works. A plug gauge was made the exact same diameter as the lathe spindle before the bronze worm wheel was bored to size to make sure the wheel was an exact fit for the spindle. The wheel was held by a faceplate and indicated in for concentricity with the lathe spindle before boring was begun. It takes 120 turns of the worm arbor handle to rotate the lathe spindle one complete revolution. It's slow, but very accurate.

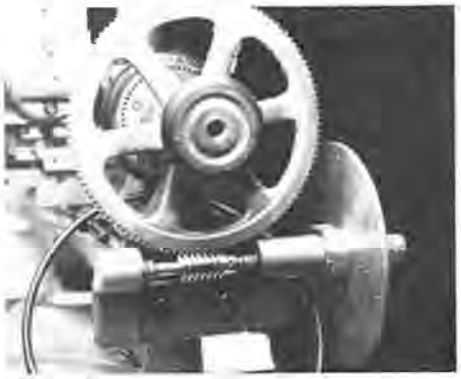


Figure 7



Figure 8



Figure 9



Figure 10



Figure 11



Figure 12

Degrees in a circle = $\frac{360}{120}$

= 3 degrees per tooth of worm wheel

$\frac{72}{3}$ = 24 turns of the handle per slot

Or:

No. of teeth in worm wheel = $\frac{120}{5}$

= 24 turns of handle per slot;

Number of divisions needed = 5

12 turns of the handle are required to position the cutter over the center of the space between slots. 24 turns are then required to position the cutter to generate each of the remaining three curved surfaces.

One way to get an idea of component proportions is to study and measure a working stopworks, and then scale the measurements up or down to fit the job at hand. An electronic digital caliper, having a resolution of 0.0005 inch (0.012mm) is a good measuring tool for this work.

Once the measurements have been determined for the piece we want to make, a piece of steel stock is turned as illustrated in Figures 9 and 10. The front diameter is turned to the full size of the star wheel. The smaller diameter immediately behind is turned to the depth the slotting saw is to reach. The larger third diameter being turned is the depth the curve cutter is to reach. Turning the easily measured reference



Figure 13

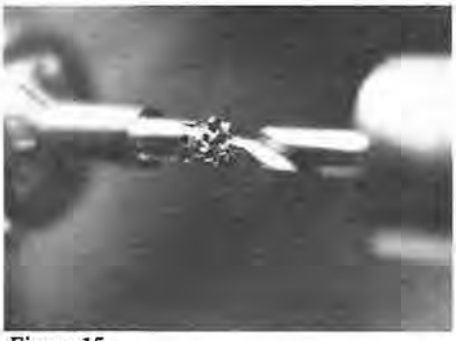


Figure 15



Figure 17



Figure 14



Figure 16



Figure 18

diameters is a more reliable and faster method of establishing cutter limits than relying on the graduations on the milling attachment.

Figure 11 shows the milling cutter cutting the curved surface to depth. After all four curved surfaces have been cut, a slotting saw is being used to cut the five slots to depth in Figures 12, 13, and 14. The cutting tools are lubricated with beeswax. A center drill is spotting the work in Figure 15 so a hole can be drilled through the part as illustrated in Figure 16.

Figures 17 and 18 picture a conical burr being used to counterbore the part for the screw head. A tapered brass rod has been inserted into the



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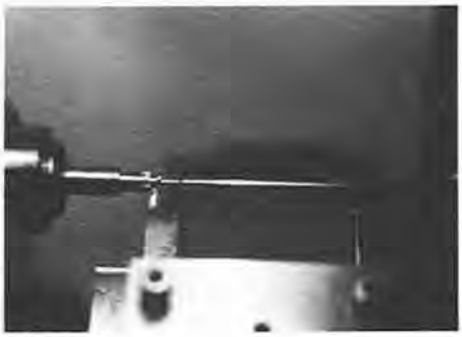


Figure 19



Figure 22



Figure 25



Figure 20



Figure 23



Figure 26



Figure 21



Figure 24

drilled hole to capture the work as it is parted from the stock in Figure 19.

The part has been deburred and straight-line-finished in Figure 20. A screw is being made in Figure 21. The star wheel has been mounted to the barrel cover in Figure 22.

The lathe spindle holding the barrel arbor has been locked in place in Figure 23. The barrel has been rotated about three-fourths of a turn to preload the mainspring in Figure 24 and the finger piece installed in the lock-down position (see also Figure 3). The barrel was removed from the lathe (Figure 25) and installed in the fine minute repeater with chronograph pictured in Figure 26.

The number of hours the watch will run per revolution of the mainspring barrel is found by dividing the number of teeth in the barrel by the number of leaves in the center wheel pinion. This hourly value times four is the total number of hours this stopworks will allow the watch to run. Some customers may be surprised to find that their restored watch will only run a little more than 24 hours. It is a good idea to let the customer know why the watch will run a certain number of hours.

While this is a fun project, quite a lot of time is required to determine dimensions and to make the star wheel. Price your work accordingly. ❑



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A New Training Program from AWI

AWI Academy for Advanced Watchmaker Study

The American Watchmakers-Clockmakers Institute has known for some time what is now prompting trade magazine articles and industry concern. With renewed consumer interest in the mechanical watch and watches with many complications, there simply will not be enough competent repairers to handle repairs when these timepieces find their way into shops for service.

Existing service facilities are hard-pressed to find competent repairers to handle these watches now. For several decades there has been a steady decline in the number of highly skilled watchmakers entering the field. This decline has gone unchecked because at one point it appeared that highly skilled craftsmen to service timepieces was no longer a priority due to the advent of the quartz watch and the popularity of disposable watches.

The Swiss watch industry estimates the need for 25,000 skilled watchmakers within the next 10 years. As a result of their concern they have budgeted $1.1 million to finance help to existing schools. In April, AWI arranged a conference between American watchmaking schools and Antoine Simonin, Director of WOSTEP and Administrator of the new Swiss industry project. The Swiss plan is to provide a uniform curriculum for watchmaker training on a worldwide basis. As a result of the April conference, three U.S. schools and one Canadian have opted to participate in this Swiss program. They are: National Institute of Watchmaking (formerly Joseph Bulova School), Woodside, NY; North Seattle Community College, Seattle, WA; Oklahoma State University/Okmulgee, Okmulgee, OK; and Polyvante Ste-Ursule, Trois-Rivieres, Quebec, Canada. The graduates from these schools should improve the quality of journeymen watchmakers for years to come.

Another serious problem exists. The highly skilled specialist, the specialist that journeymen and service centers rely on when they are called upon to service watches with many complications, watches which require the design and/or fabrication of special parts, has virtually disappeared. Today a handful of such specialists are so over- burdened with work, they restrict their service to a few clients who compensate them generously.

AWI is establishing the AWI Academy for Advanced Watchmaker Study in conjunction with its existing education center which has been operating Project Extend. The curriculum for the Academy is at the graduate level and will be presented in two sections. The first section is scheduled for August 1, 1994 through October 7, 1994. The second section is scheduled for October 10, 1994 through December 16, 1994. Our goal is to train a minimum of 50 highly skilled specialists within the next five years. While AWI is prepared to contribute substantially to this project, it cannot be implemented without financial support for those who will benefit from the services of Academy graduates.

A drive to secure pledges and financial contributions is presently underway. Each graduate will require $7,000 in support from individuals and industry. The Academy can train 12 graduates per year. Those interested in more details and those wishing to offer financial support, should contact the American Watchmakers-Clockmakers Institute, 3700 Harrison Avenue, Cincinnati, OH 45211; (513) 661-3838; Fax (513) 661-3131. ❑

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By J.M. Huckabee
CMC, FBHI

About . . .

EFFICIENT USE OF TIME

and

MAKING WHEELS



Q. What do you think of the let-down tool with interchangeable key sizes? Is this preferable to a couple of double-ended keys?

A. I'm charmed with many of the tools found in catalogs that supply clockmakers supplies. We see many very nice tools, as the two you described.

My working years were spent mostly in industry, working under great pressure for higher quality and greater productivity. Consequently I judge tools in terms of effective use of time and quality of results.

I do not use, not even own, a 5-prong winding key. Why? Each time we reach for the key we have a 4:1 possibility we have the wrong size. Life is too short to spend time hunting a clock key! As for the double-end let-down tools: I have two of these and the probability is 3:1 that I pick up the wrong size.

What do I do? The clock must have a key, either a shop key or the owner's key. Keep it with the clock. If it's the owner's key, fine; if not, sell him the shop key. For let-down I use a one inch dowel about six inches long. This has a hole in one end and a slot to accommodate a clock key. Now that tool fits all clocks on first try. Here we solve two time robbers with a simple tool and a little self-discipline.

Let's think about lathe tools. I have about 20 gravers with identical handles and bits. When I sharpen these, the entire lot is put into good condition. That's time efficient in unit time required per tool. As the tools dull, the next one in use has the identical feel of the previous one--no lost time. I grind the gravers rather than using an oil stone. This can be done at the rate of two to four tools per minute--that's a great timesaver.

Making all repairs before cleaning is another way to speed final assembly and have a nice clean job quickly. Sometimes a movement is rinsed before disassembly if the conditions so require.

Practice never using pliers on a nut; an open-end wrench or a socket is faster. Use long screwdrivers with round shanks, and always use the proper size. This saves time and does not mar the screwheads. The purpose of long shank drivers is to spin the driver between a thumb and forefinger. Break the screw loose with the handle and then spin the shank. With a little practice, you will be able to rival an air driver in speed. The same is true on reassembly. I like wood handle drivers because they are easy on the hands.

Most of us were taught to place round rod stock in the lathe and cut it off with a jewelers saw. Nothing wrong with that, except it is not time efficient. A thin cut-off tool can make four cuts through a piece of 1/8 inch brass rod while making one saw cut, and you are not using and breaking blades.

Concentrate on time-efficient practices, and in a short time you will be able to turn out an additional job every day, and with no extra effort! The extra profit is all yours.

Q. Wheel work is an interesting subject that I would like to know more about. What are the problems in this work?

A. I don't know that this work has any serious problems, but it does require a myriad of skills and details not commonly practiced in our trade. The scope of tools needed is also beyond those found in most repair shops. I made my first gear a little over 50 years ago, and have done so on a regular basis for about 30 years. Be assured that this is a work that cannot be taken lightly!

I find escape wheels and ratchet wheels to be the easiest to deal with. Wheels that must function in the mid-section of a clock train are probably the most critical, and contrate wheels the most difficult. The problems stem from how to cut and hold the wheel blank, troubles with cutter flash-cleanup, support and backup devices, cutting the windows and spokes, etc. Still another problem is matching the tooth profile of associated wheels, cutter sharpening, and lathe work.

It is not generally feasible to make gears to a trial-fit. This requires good measuring tools and techniques and working to theoretical dimensions. An added factor is that a good gear is not a good job until it has a hub and assembled accurately to its arbor.

Like much other literature in our trade, there is very little instruction available from a writer who has had extensive hands-on experience. Consequently, the beginner has a big problem in developing good work practices.

Clock gearing is generally based on a modification of a cycloidal curve. Instrument gearing is usually based on a modification of an involute curve. Add to this the "designers choice" of the original gearing, and you can imagine the problems of duplicating a tooth profile.

The best text I know is *Gears for Small Mechanisms* by W.O. Davis, NAG Press, London. The first edition has been out of print for about 30 years. Subsequent editions are also good, but directed primarily to instrument gearing. Mr. Davis deals with theory, terminology, measurement techniques, manufacturing tolerance, profile development, and a variety of methods of the cutting process. He includes some of the profile standards of Swiss, British, and Black Forest clock industries.

I recommend obtaining a copy of the Davis work; start studying the profile of gearing passing your way, learn to size wheels and tooth profile, ratios and center distances, etc.

Finding the intrigue of gear study may lead you to a whole new facet of clockmaking. But be advised--making pinions is still another venture. Even though wheels and pinions are closely related, the pinions add additional circumstances. ❑

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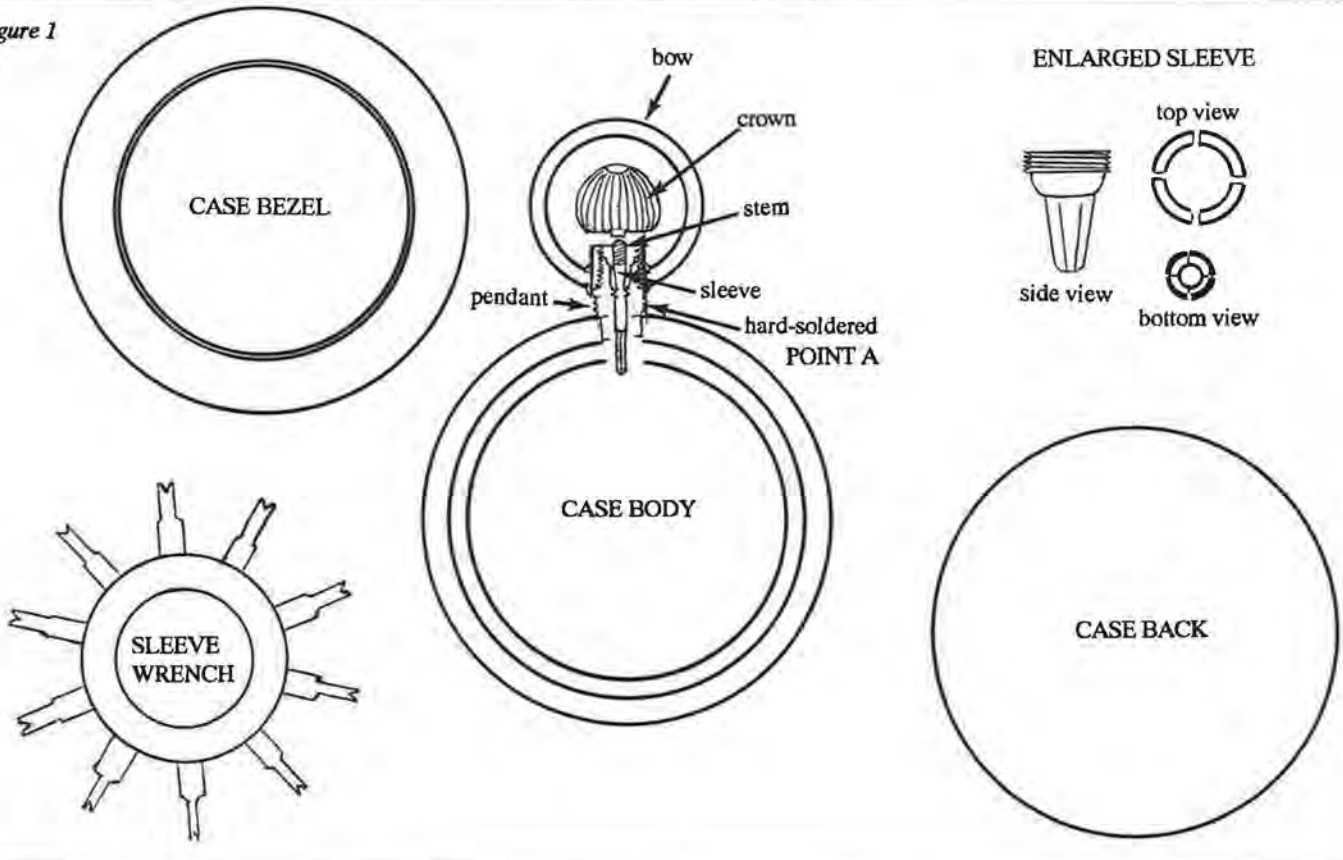
As a jewelry craftsman and repair person, watch case repair falls within the same skills as we need for jewelry crafting and repair. Thus, in this article, I will try to discuss some of the case problems that I have encountered in my experience.

Mechanical watches can cover a variety of case types such as pocket watch cases, repeater and chronograph cases, gent's wristwatch cases, and ladies' watch cases. Pocket watch cases can be open face or hunting cases (with a lid over the dial and crystal); lever set or stem set; screw backs and bezels, or snap backs and bezels. Many pocket watches had glass crystals, but some had plastic. Both have their advantages and disadvantages. Gent's wristwatch cases are probably of two general types: waterproof (or resistant) and dress cases. Many water-resistant cases are screw back with a gasket and plastic crystals that are compressed to shrink the diameter. The pressure, when released, gives the crystal a tight, water-resistant fit. The crown for winding and setting has a gasket that fits tightly over a case tube. These cases use a gasket in conjunction with the screw back to make the case water-resistant, or even waterproof.

The gent's dress watch cases are many shapes and the bezel usually snaps over the back, or vice versa. Most men's watches have lug ends, and the wrist band is fastened with spring bars. Ladies' watch cases are made much the same as men's; some are water resistant and others dress. However, most ladies' mechanical watches have the band fastened with a loop end on the dress cases while the water-resistant cases, like the men's, had lug ends requiring spring bars to attach the band.

Materials used to make watch cases for mechanical watches has been mostly metal. The super-fine watches have used platinum, the fine watches karat gold, the good grade watches gold-filled, sterling silver, or stainless steel. Inexpensive mechanical watches were often put in aluminum cases. Starting with pocket watches, I'll try to list some of the most prevalent problems needing repairs or corrections.

Figure 1



Open Face Pocket Watches

These are found with both snap or screw bezel and backs. Most American-made pocket watches have a stem-crown for winding and setting. They use a sleeve that is threaded to screw down in the pendant; the sleeve has four snap fingers that snap the stem from the winding position when pushed in, and into the setting when pulled out (Figure 1). Sleeves can be adjusted for depth by screwing deeper or shallower by turning the sleeve with a sleeve wrench.

Lever-set watches will wind or set from either position, but to remove the movement from the case the stem must be pulled out to the setting position. Lever-set watches were required on all railroad watches so they could not accidentally be put in setting position. The only way they can be set is by removing the bezel and crystal, pulling out the set lever, then setting the hands by turning the crown. When set to the correct time, push the lever back in, and replace the bezel and crystal.

Repairs on this mechanism aren't usually necessary--except when the pendant must be removed from the case and repaired or replaced with another one. I know of no place where replacement pendants are available; however, a used one can be removed from an old salvage case and installed. This is when it becomes necessary for the jewelry repairman to reassemble the stem, crown, and sleeve, and make necessary adjustments. These cases are almost trouble-free, except for crystal replacement or dent removal. Occasionally, the threads get a nick in them. This usually happens on the male thread which can easily be removed with a very small triangular needle file. When the threads do not work free, a small amount of lubricant--such as stem grease--can be used to make them screw on more freely. The metals found in these cases usually are karat gold, sterling or coin silver, gold-filled, nickel, or a plated base metal.

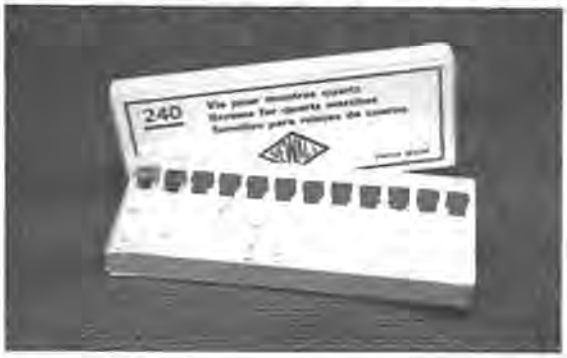
Hunting Case Pocket Watches

These are made in the same sizes as the open-faced cases. The winding and setting mechanisms are almost the same except the hunting case setting components can, after being pushed in winding position, be pushed farther to open the lid. Lever-set watches can be set with the lid open without removing the bezel and crystal. One other difference is that the stem is located at 3 o'clock on the watch dial, while with the open face watch the stem is located at 12 o'clock.

There are problems in hunting cases not found in open face cases, because they have three snap lids, two on the back and one over the crystal. Each lid has a hinge made up with three small tubes, two of which are attached to the case body, and one is attached to the lid. The hinge tubes are soldered in place with hard solder, and a hinge pin goes through them to form the hinge. Often, due to rough usage, one, two, or even all three of these tubes gets damaged and need to be replaced. Usually there is a small plug in each end that can be removed with a sharp graver; this leaves access to the hinge pin for removal.

To remove the hinge pin (which is usually a tapered pin that is pushed in from the right side to the left), push it from left to right. If a pin pusher won't move it, I take a needle that is smaller than the small end of the hinge pin and grind the point off as well as the eye. With the altered needle, I usually can tap the hinge pin out using a brass hammer. Often at this point I find only the single tube in the lid needs to be replaced. In this case, I first dip the lid in boric acid and alcohol, then burn it off to keep

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the lid from oxidizing. Then I heat the tube until the solder starts to flow, and lift it off with a solder pick. Measure the diameter of the tube and find a piece that matches the outside diameter. Cut it to the identical length of the old tube. Make sure the lid where the tube goes has a depression for the tube to go into, and seat just like the old one. Often there will be enough solder in the groove to solder the new tube in when fluxed and heat applied. If not, re-flux, and lay a small chip of solder on the tube. Again apply heat until the solder flows and is secure with the lid.

When positioning the tube, it should be in the exact same position as the old one. When this is done before cleaning it for installation, it can be fitted into the case, using a needle for a temporary hinge pin to see if the fit is proper and that the catch will work and release. If the hole in the tubing is too small, a tapered broach can be used to enlarge it to accept a tapered pin. When the lid is closed and you are looking down on the lid with the hinge to the bottom, the tapered pin should be inserted from the right side and pushed through to the left.

To make a tapered pin, use either nickel silver or brass wire. Choose a size that will enter the right-hand (larger hole) tube. Using a pin vise, the pin can be filed to a taper or it can be chucked in the flex-shaft tool and rotated while filing.

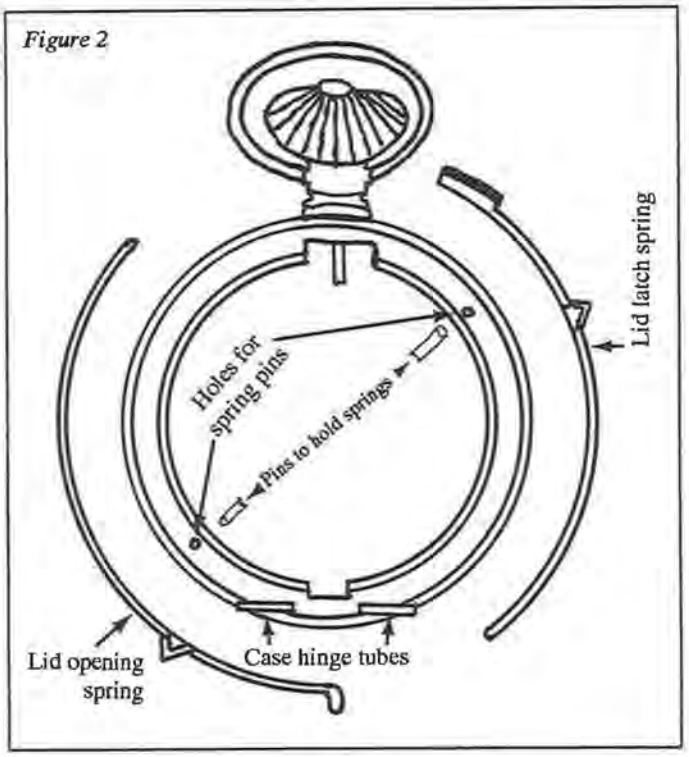
Many adjustments in watch and jewelry repair are done by bending, the same applies to this case lid. Sometimes they have to be aligned, which can usually be done by bending with the hands and fingers. If the catch doesn't want to hold and the lid will not adjust to make it work, it may be worn. This can be repaired by gold-soldering a sliver of metal where it is worn. The flat edge can be filed smooth, then with a bearing or inverted, cone-shaped bur in the flex-shaft tool, the repair can be undercut to match the inside of the edge. This should restore the lid back to its original condition.

Repair of the lid is much less complicated than repairing the parts (tubes) on the body of the case. This is because inside the case there are two springs curved to fit the round contour of the case; these must be removed because they will not stand the heat required to make the hard solder joints when replacing the hinge tube(s). (Figure 2 shows a case drawing with the two springs removed.) The springs are held with small brass pins inserted in the holes shown in the edge of the case into the Vs in the springs. They are sometimes difficult to remove, There is usually enough room inside the case between the edge and the spring to use a sharp instrument such as an engraver's flat graver to push them out far enough to grip them from the outside edge and pull them out.

When the springs are removed, and after marking the position of the damaged tube(s), flux and heat can be applied; when the solder flows, they can be removed. The replacement tubes can be cut and installed the same way as the single tube on the lid. After the lid is finished and replaced, the springs can be re-installed in the reverse of the disassembly. One of the two springs is for the purpose of making the lid catch; the other is to make the lid open when the catch is released.

One of the more common problems that I have encountered in pocket watches is the bow wearing where the ends enter the pendant. Often this can be corrected with a new bow with flat ends. If the old bow is worn to a point and the pendant holes are worn to a taper, often there is enough metal available on the pendant ends to file flat and re-drill the holes deep enough for the new bow to seat. This will correct the problem. When there isn't

Figure 2



enough metal, a piece can be hard-soldered to fill the hole, which can be reshaped by filing, and finally drilled to fit the new bow. When this will not work due to any other cause, the pendant must be replaced.

As I stated earlier in this article, I don't know of any source for new pendants. It's best to find a salvage case with a good pendant, one that will match the one being replaced. The salvage pendant and the one to be replaced can be removed from the case by heating until the hard solder holding it in the case starts to flow. Now it can be lifted out. If this is a hunting case, the steel case springs will need to be removed before applying heat so as not to draw the temper out of them. The replacement pendant can be installed by putting it back in place and hard-soldering it like the original one was.

Pocket Watch Crystals

These are mostly round with different contours governing height. Some of the old 18s cases had flat, thick crystals; others were raised with a curved edge and then flat on the top. Hunting case crystals are very thin glass. They have a numbering system, and each number has sub-numbers of 12 sizes to a number. I always order the old VTF round hunting or regular pocket watch crystals by 1/4 dozen. The three crystals in the quarter dozen would vary a little in size, so if one was too large, usually one of the other two would snap in the bezel. By maintaining a full cabinet with three of a number, almost any crystal could be fit to a snap fit, thus requiring no cement to hold it in. Today it is questionable if these glass crystals are readily available. We have an alternative in plastic round and even hunting crystals.

In next month's article, I'd like to discuss more details of watch case repair, and problems including old American watch stem, sleeve, and crown replacement and installation. Since many of these parts are no longer available, our discussion will be on alternatives. ❑

Making a Minute Snail and Quarter Snail Assembly for a Minute Repeater

Part 2



Ron DeCorte, CMW

In Part 1 of this series of articles, I discussed the different measurements that are needed for the fabrication of the minute and quarter snail assembly, and also the drawings that are required. In Part 2 I will discuss the special cutters needed and the fabrication of the parts.

--Ron DeCorte

SPECIAL CUTTERS

Figure E is a typical minute snail. As you can see, the shape and detail are quite complex. Particularly note that the last 2 or 3 steps are under the first 2 steps. This makes machining these details impossible with standard (off the shelf) milling cutters. Obviously, some sort of special cutter is necessary to accomplish the task.

Figure F shows a special cutter that I made in order to machine the last 2 or 3 steps of the minute snail. This cutter is modeled after one that I was shown while in Switzerland recently. The cutter was fabricated from a 1/2 inch piece of 0-2 drill rod. The finished cutter was hardened and then tempered to a light straw color. Note that the linear dimensions in Figure F are only a basic guideline; the actual dimensions may vary according to the job and material at hand. The 0.5mm diameter shown in Figure F, detail A is about the same width as the longest step on the

FIGURE E

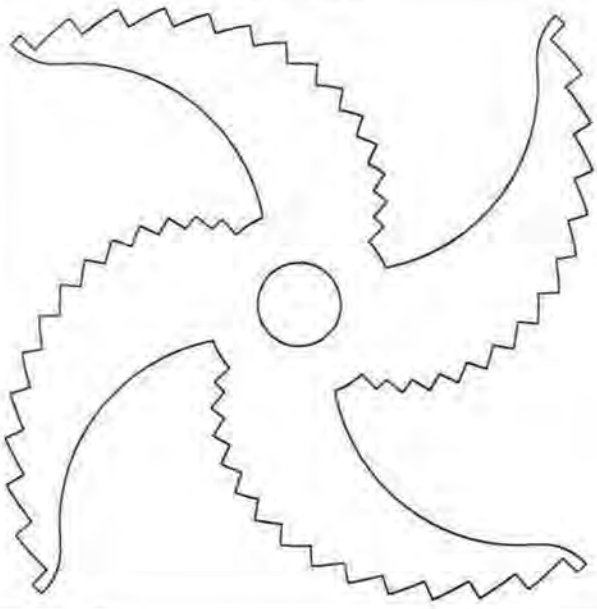
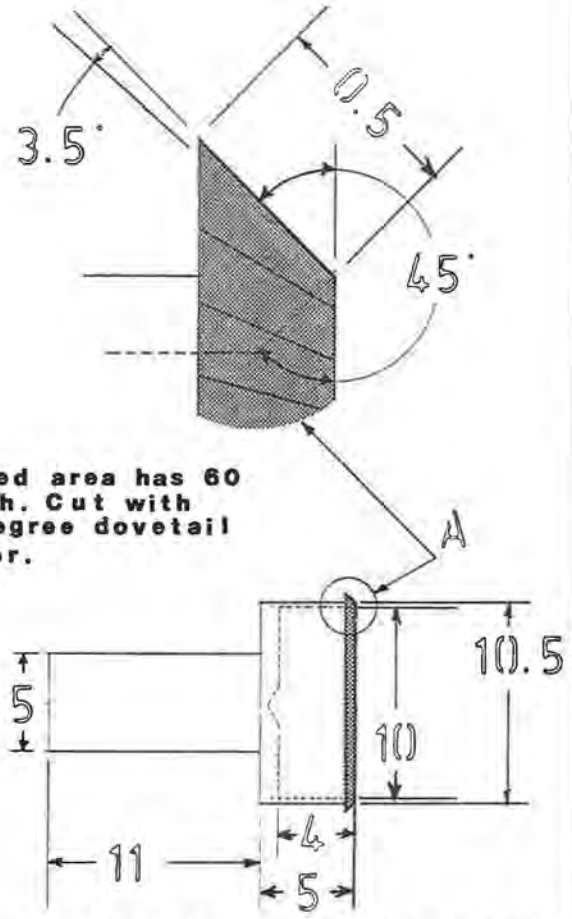


FIGURE F



minute snail that I was making. This cutter has 60 teeth around the circumference, and these teeth form a 45 degree cutting surface.

Figure G shows the above-mentioned cutter fabricating the 14th step of a minute snail. Note that the shaded area of the snail has rotated up inside the hollow cutter, allowing access to the last 2 or 3 steps of the snail. In Figure G, arrow A shows the direction of the cutter movement and arrow B shows the rotation of the snail as it is fabricated. Note that the cutter is set at a 45 degree angle to the work.

In order to arrive at a 45 degree cutting angle on the special cutter, the cutter that was used (60 degree dovetail) to cut the 60 teeth had to be offset 3.5 degrees as shown in Figure F, detail A. I have devised the following formula to find the offset angle for any particular cutter and any number of teeth to be cut.

360 divided by number of teeth to be cut = angle A

Angle of the cutter used to cut the teeth = angle B

TANGENT of angle A multiplied by COTANGENT of angle B = SINE of offset angle

Example: A 60 degree dovetail cutter is to be used to cut 60 teeth as in the above-mentioned special cutter.

360 divided by 60 = 6 degrees

Angle of cutter = 60 degrees

TANGENT of 6 degrees = 0.1051

COTANGENT of 60 degrees = 0.5774

0.1051 multiplied by 0.5774 = 0.0607
= SINE of 3.48 degrees

Figure H shows another special cutter that I have used in making minute snails. This cutter looks basically the same as the cutter shown in Figure F. The difference is that the cutter shown on Figure H is not set at a 45 degree angle when cutting. This cutter is set at a 90 degree angle and the cutting diameter marked A in Figure H is used to form the surface of the steps. Also note that the face marked B in Figure H is also a cutting surface. Face B is angled at 6 degrees to the front surface so that it helps form the back slope of the leaf of the snail as the snail is rotated into the cutter. All other dimensions except those noted in Figure H are the same as that for the cutter shown in Figure F.

The cutter shown in Figure H is the one that I like to use. But it is more difficult to fabricate than the one shown in Figure F. The reason for this is that there are two surfaces that must have teeth cut on

FIGURE G

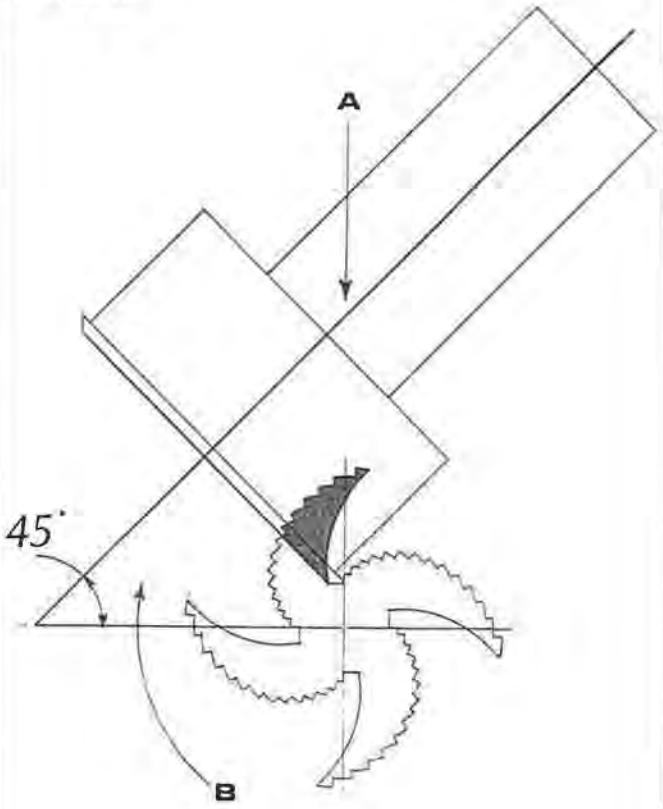
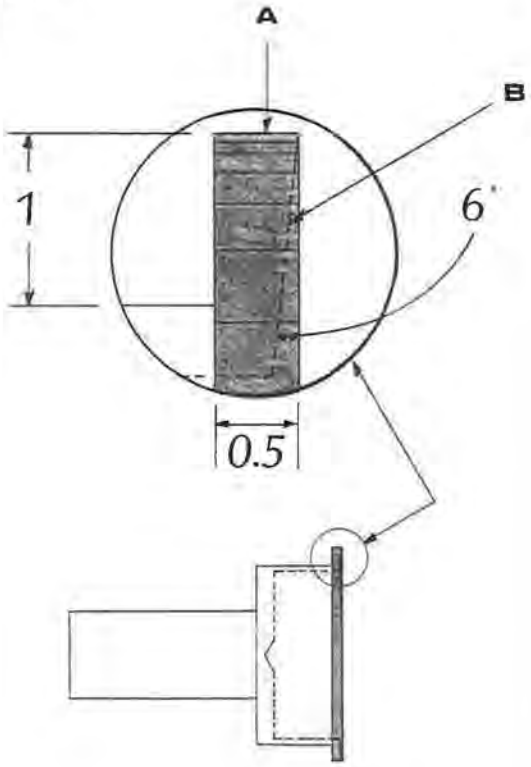


FIGURE H



them. It is important that the teeth cut in diameter A and those cut in face B are in perfect unison. Otherwise the corner formed by their intersection will be weakened and irregular.

FABRICATION

The fabrication of the minute and quarter snail assembly is where all of the preceding work in design and making cutters will pay off. Although the work to be done requires complete concentration, if the drawings and design work are correct and the machinery to be used is up to the task, the work will go quite smoothly.

Preparation of a workpiece is the first step in the fabrication process. In basic terms, the workpiece is a disc of steel when it starts out. You may wish to cut a disc from a flat piece of steel stock. You may turn a disc from a round piece of stock and then part it off, or you may turn a disc at the end of a round piece of stock and leave it attached until the machining operations are complete. If you choose one of the first two methods, then you must mount the workpiece on some sort of mandrel in order to hold it in the machine (lathe). Photo 1 shows a workpiece mounted on a mandrel. The workpiece has a hole in the middle and is riveted onto the end of the mandrel. Photo 2 shows a workpiece that was turned at the end of a short piece of drill rod. I prefer the latter method since it saves several operations and the workpiece is not apt to move on the mandrel during the machining operations. The workpiece should be turned to the proper diameter before the next operation is started and should be about 0.5mm thick.

The first step in machining the steps on a minute snail is to mount the workpiece in the lathe spindle. The spindle should be equipped with an indexing attachment that is suitable to achieve the required angles of rotation that are needed for the job. A worm gear type indexing attachment is best suited for this type of work. If the workpiece has not been filed to a rough shape, then it must be milled out to a rough shape at this time. Photo 2 shows a minute surprise piece being milled from a solid disc. This same method can be used to rough out the minute snail. If you try to remove all of the metal required with one of the special cutters for the minute snail, you may break the cutter or at least dull it before finishing the job.



Photo 1



Photo 2



Photo 3



Photo 4

The special cutter is now mounted in the milling attachment and lined up with the center line of the spindle and workpiece. This arrangement is shown quite clearly in Photo 3 and Photo 4. The workpiece is rotated so that the cutter is positioned



Photo 5



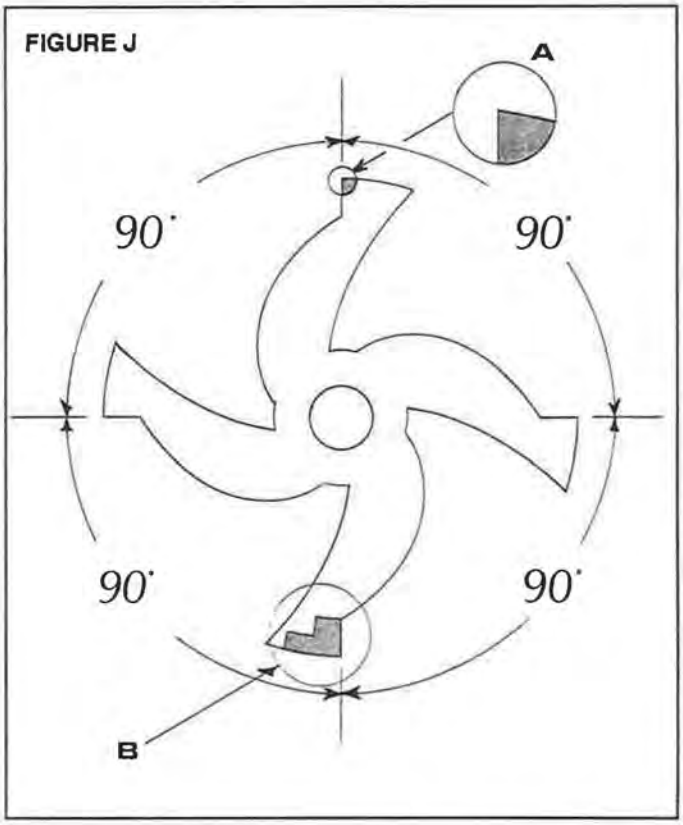
Photo 6

over the area that you wish to cut the first step of the snail. Move the cutter down and into the workpiece the proper amount for the first step. Leaving the cutter at the above-mentioned depth, rotate the workpiece (headstock) the required amount to the next step. Once again, move the cutter into the workpiece and then rotate. You will find that when you reach the last step or so you will start removing a lot more material with the advancing edge of the cutter as you rotate the work. It is VERY important at this point that you do not try to make the cutter do more than it was designed to do or it will break. Once you have machined the last (14th) step you must retract your cutter from under the advancing leaf of the snail very carefully.

You are now ready to start machining the steps on the next leaf of the snail. It is important to note that each time you start a new leaf, the starting point must be 90 degrees from the starting point on the last leaf. When all of the steps on the snail have been cut, you may remove the workpiece from the mandrel or part it from the rod to which it is attached. Photo 1 shows a minute snail with all of the steps machined.



Photo 7



The minute snail is now placed in the vise or held in the hand and supported against a filing block. The back slope of the leaves must be filed to the proper shape. Note that it is VERY important that you do NOT foul ANY of the teeth in the snail during this operation.

The next step in machining the minute snail is to prepare a cement chuck for finishing the thickness. A piece of brass is faced off and a pocket is turned in the end to the depth that you wish the finished snail to be plus a little extra (0.05 mm) to allow for final finish. The diameter of this pocket should be the same size as the largest diameter of the snail. Heat the brass cement chuck and apply shellac, then secure the snail into the shellac. You may now face the snail to the proper thickness and finish the



Photo 8



Photo 9

center hole if necessary. Photo 5 shows a minute surprise piece mounted in a cement chuck and faced to the proper thickness. This is the same process used for the minute snail. Don't forget to make a hole in one of the leaves for the banking pin. The minute snail is now ready to be hardened and tempered and the final finish applied. Photo 6 shows a finished minute snail as compared in size to a dime.

The minute surprise piece will command our attention next. Although the surprise piece is much simpler than the minute snail in its complexity, there are some very important details to note. Figure J shows a typical minute surprise piece. It is important that the acting corners shown in Figure J, detail A be sharp and exactly 90 degrees apart as shown. It is also very important that the surprise piece be completely hidden under the minute snail except for the shaded area shown in Figure J, detail B.

The surprise piece may be fabricated in a number of ways. You may choose to file the work completely by hand or you may choose to use machinery. I prefer the latter. The method I use is to first turn the workpiece to the desired diameter. Then use a standard milling cutter as in Photo 7 to finish the radial edges as shown in Figure J, detail A. The same milling cutter is then used to rough out the rest of the workpiece. The finished curves are completed by hand with a file. The workpiece is now mounted in a shellac chuck prepared in the same way as the one used for the minute snail, see Photo 5 for detail. The work is faced to the proper thickness and any holes required are drilled. Harden, temper, and finish as required. Photo 8 shows a finished minute surprise piece.

The quarter snail is very simple to fabricate compared to the minute snail and surprise piece. All of the steps can be cut using a standard milling cutter. The clearance area for the banking spring (if required) can be made by drilling a series of holes and then connecting these holes by filing. Don't forget the provision for the trip pin (or boss) that engages the hour star wheel. The quarter snail is also hardened, tempered and finished as required. Photo 9 shows a finished quarter snail with the banking spring installed.

Part 3 will continue next month.

❑

WE'RE INTERESTED IN YOUR COLOR SLIDES

The American Watchmakers-Clockmakers Institute knows that there is a wealth of talent in its membership and that this talent is not only in the field of horology. There is seldom a gathering of a group of watchmakers and clockmakers where a camera is not also there.

Those of you who pride yourself in the beauty of your camera work can possibly participate in having your own picture reproduced on the cover of *Horological Times*. The covers of *Horological Times* are reproduced from color transparencies or slides. Remember, the format is scenery or nature and what you submit must be a color slide. Color photos are not acceptable.

If your color slide is used, you will receive an 8-1/2 x 11 inch color photo. It will be framed and sent to you for your enjoyment. Mail your color slide with description to: **Horological Times, P.O. Box 11011, Dept. 31, Cincinnati, OH 45211. All slides become the property of the American Watchmakers-Clockmakers Institute.**

Association News

NEW YORK

On Monday, June 7, Lou Zanoni, who first applied LCD to a wristwatch and is now the owner of Zantech, gave an informative program to the Horological Society of New York.

The highlight of this presentation was the rapid cleaning of quartz movements. In his demonstration, the cleaning procedure involved merely stripping the dial, circuit board, and coil, providing access to the rotor wheels and pivot holes. These were sprayed with a quartz cleaner and dried with compressed air. In a matter of moments, the movement was cleaned.

Mr. Zanoni also described some of his unusual equipment and supplies and distributed his Zantech catalog.



Officers of the Horological Society of New York 1993: (left to right), seated: Frank Carpathia, editor; Howard Fass, president; Henry Loeser, executive committee; standing: Jose Saleado and Valentine Wong, executive committee; Dan Richter, sgt. at arms; Walter Paneretitsch, executive committee; and Ben Matz, recording secretary. Not present for the photo were Ted Fishkow, vice president & treasurer; Al Rudnick and Jack Schecter, executive committee.

NORTH CAROLINA

The Coastal Plains Guild hosted the North Carolina Watchmakers Association Annual Convention in Raleigh, NC in June. On Friday, AWI Instructor Jim Broughton presented the Servicing ETA Quartz Chronograph bench course. Friday evening Bill Tolbert from Cas-Ker Co. demonstrated the use of the Kronoglass Crystal Cutting Machine. Eric Parris demonstrated the use the Schohl Crystal Cutting Machine. The association hosted the old tool auction.

Saturday morning AWI Instructor Roy Hovey gave a slide presentation on restoring a French clock. Questions and answers brought out a wealth of information and instruction. Damian Deblis from Tiffany's New York spoke on the value of giving superb customer service and procedures on handling customers' repairs. After lunch, Robert Miller from International Dial Co. shared a slide presentation on refinishing dials and the unusual challenges to do the best quality work on each dial. August Cornell from New York State shared techniques on repairing new watch bands and a hands-on demonstration on custom fitting the latest stems and crowns of different tap sizes. Also covered were quick bench tips, mainspring repairs, and modifying tools to open today's watches.

Henry Fried was guest speaker at the Saturday evening banquet. During the dinner Mr. Fried was presented with the award of Fellow North Carolina Watchmakers Association.

Sunday morning Henry Fried presented a slide program on "Breguet Watches & Clocks at Auction, Who Opened Them and Their Insides"--an outstanding presentation on the French clocks and watches with their excellent craftsmanship and inventions.

The following officers were installed: Chris Wiles, president; H.B. James, 1st vice president; and Scott Lemons, 2nd vice president.

OHIO

The Watchmakers Association of Ohio will hold an auction on Sunday, October 10, 1993 at 12 Noon. The auction will take place at the American Legion Hall, Southway Post 144, 3253 South High Street, Columbus, OH. For more information contact Karl Farnlacher, Dayton, OH, (513) 275-3172.

UPCOMING ASSOCIATION CONVENTIONS & MEETINGS

September 18	**Arizona Watchmakers, Clockmakers & Jewelers Annual Convention,** Best Western Inn - Airport, Tucson, AZ.
September 18-19	**Horological Association of Indiana Annual Meeting & Fall Workshop,** Indianapolis Motor Speedway Motel, Indianapolis, IN.
October 1-3	**New York Watchmakers Association Convention,** Holiday Inn, Seneca Falls-Waterloo, NY. AWI Speaker: Fred Burckhardt.
October 8-10	**Illinois State Watchmakers Convention,** Clock Tower Inn, Rockford, IL. AWI Speakers: Alice Carpenter and Buddy Carpenter.
October 29-31	**Florida State Watchmakers Association Convention,** Ramada Hotel Resort, West Palm Beach, FL. AWI Speaker: Ewell Hartman.

Affiliate Chapter Column

Affiliate Chapters Need to Work Together

By Greg Hostetter, CC

I want to thank all of the affiliates that sent delegates to the recent affiliate chapter meeting in Cincinnati. It was one of the best affiliate meetings in recent years. There was good exchange of ideas and opinions and several good proposals were passed.

One proposal that passed is to have an informal social type gathering before the affiliate chapter meeting, to give all the delegates a better chance to informally discuss improvements to their own chapters and AWI. I think this is an excellent idea. In talking to representatives from several of the affiliates over the past couple of months, I have found that several of the affiliates have excellent programs, ideas, and ways of running their chapter that I had never heard of in the several years that I have attended affiliate chapter meetings. Hopefully in this informal social gathering more of these ideas can be exchanged and shared with the other affiliate chapters.

There are several areas of concern facing almost all of the affiliates: membership, seminars, and finances to name just a few. If we can all work together to share what works and what doesn't, we can all benefit. It benefits each of us to take advantage of the experiences of the other affiliates.

Not only can you get answers to old problems by talking to other affiliates, you can also pick up some excellent new ideas. Did you know that some affiliates have scholarship programs? Some have very successful auctions. Many publish high-quality newsletters. Don't forget that many affiliates can offer you great ideas for conventions, seminars, and educational programs.

If you've got a question or you need some new ideas, pick up the phone or write to some of the other affiliates. We all belong to the affiliate chapters committee. Take advantage of your other committee members. If you have a question regarding a program or idea for your chapter, don't hesitate to contact one of the other AWI affiliate chapters. The names and addresses of their delegates are on the reports that you picked up at the meeting. You can also contact the AWI office for a list of the other affiliate chapters.

Special thanks to Joe Cerullo for doing such a fine job as Affiliate Chapter Director for the past two years.

❑

SCHOLASTICALLY SPEAKING
(Continued from page 12)

centers, trade shops, jewelry shops, jewelry stores, utility companies, and avionics. Knorr's suggestion to the store owner is to think again about having a watchmaker on the premises as a valuable member of the store team. The services to the customer that a professional watchmaker can provide will certainly increase the store's profits and customer satisfaction, as well as give the customers another reason to stop by. Ben Bridge, a leading west coast jewelry chain, continues to attract many graduates of the program due to good salaries, profit sharing, and other benefits.

Many graduates have also become active in professional organizations in addition to their employment, and still more continue to support their alma mater by contributing to the George Lewis Scholarship Fund which was established after Lewis' death in 1989.

Student enrollment is up; the program is attracting students from all over the country and there is currently a waiting list to enter the program. In a time when many people face uncertain futures in their chosen professions, the view of the watch and clock technology field is as good for students as the view of the mountains from the classroom door.

North Seattle Community College is a comprehensive two-year institution which also offers academic, developmental, and continuing education.

❑

Shop Talk

Adjusting Watch Band Lengths

PART 2: MAKING RIVETS



Wes Door, CMW

Last month we showed and explained the shortening process on several different types of watch bands. Most of these were easy jobs as the band link pins would slide out quite easily with a punch or screwdriver blade.

Today we will use a band (Figure 1) to show how to remove a link when the band pin is extremely tight. Figures 1a and 1b show the distance of one link which we want to remove. First we will try to punch out the old pin after assuring ourselves that this was not a screw type. (If it is a screw type and still cannot be removed with a screwdriver blade, we will still need to punch it out or even drill it out. We will discuss this later.)

PUNCH OUT THE BAND PIN

A punch (Figure 2a) can be made from a heavy needle. First cut off the pointed end back just far enough to get a nice flat surface and whose diameter is suitable for the job at hand. If desired, we can make a brass handle as shown at Figure 2b by drilling a suitable hole into one end of this brass rod. The needle can be driven into this handle and it should bottom out at the end of the hole. We should not use a piece of tubing because this full length hole will not keep the needle from slipping.

We need to start with a solid brass (or steel) rod and drill a short hole into one end. Sewing needles are great to use as they are quite hard but they can break so we need some spares that will readily fit into this same handle in case of needle breakage. Since needles taper, we must be sure that their largest diameter will still be small enough to clear as it is used to punch out the old pin. Figure 2c shows the band that we need to set over a suitable hole in our anvil, then we will line up our needle and use a hammer to tap out the pin.

DRILL OUT THE OLD PIN

If it is impossible to punch out the old pin, it will be necessary to drill it out. Before drilling we need to make a small centering mark into the end of the pin that we are going to drill out. Normally we would use an automatic spring-loaded centering punch, but this might cause some problems. If the pin is quite small, this center punch may have the tendency to re-rivet the end.

We would think this wouldn't matter since we are going to drill it out anyway. I prefer to use a small round-end dental carbide bur as shown in Figure 3a. It is easy to control when chucked up in a flex shaft unit as shown in Figure 3b. We now can drill a small indent in the center of the end of the band pin. Then we may find that this small round tip dental bur may remove enough metal to allow the pin to be pushed out as shown in Figure 2. If not, we will need to drill. Figure 4a shows a drill set up to drill through the old pin. Incidentally, a flex shaft setup is ideal for this job; however, some may prefer to use their lathe.

We may want to partially drill from each end instead of drilling all the way through from one side. This may be safer as it may prevent the drill from breaking off and will help to prevent the drill from slipping off center. Another reason for drilling from each end is that we may find it necessary to drill only a short distance from each end and then the pin may push

FIGURE 1

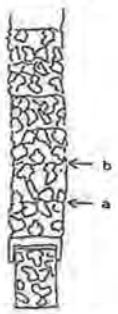


FIGURE 2

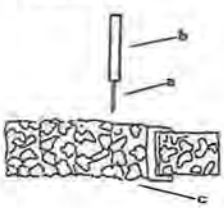


FIGURE 3

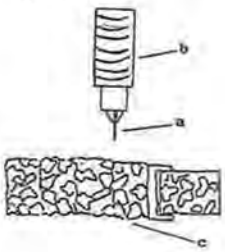


FIGURE 4

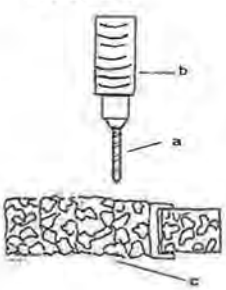


FIGURE 5

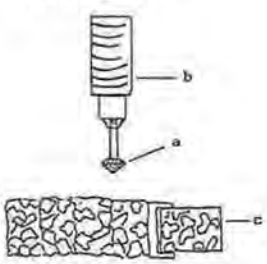


FIGURE 6

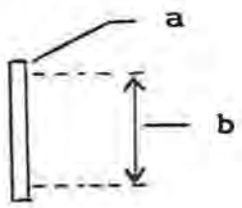


FIGURE 7

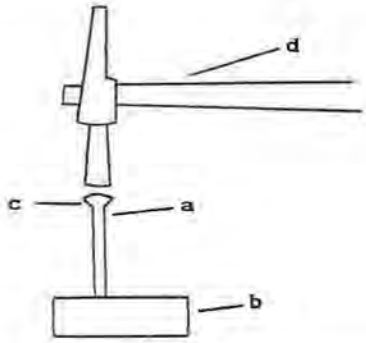
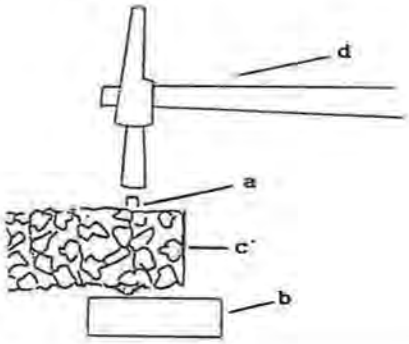


FIGURE 8



out with a punch.

COUNTERSINK THE HOLES

After the pin has been removed (by punching or drilling), then we need to countersink the end of each hole. This is very important. Figure 5a shows a countersink tool ready to be used. Actually this is a 45 degree setting bur which works great for this purpose. A more readily obtainable 60-degree setting bur will also work well. This question may come up, "Why do we countersink when the factory did not?" The answer is simple. We are doing a better job than the factory did. In most bands the factory just pushed a straight, walled pin in place. Some of these are tight from the factory, but most of our jobs will be because the factory used pins that were loose or have loosened. In fact, many of the jobs come to us for band repairs because the band pins have been lost. We certainly do not want to slip in another loose pin and have it fall out after we do the job. So we will do a proper (better than factory) job, even though it takes us three minutes longer to do it right. Besides, we are charging for a first-class job.

Now back on the job. Someone might ask what countersinking is and why it is important. To countersink, we cut away a cone shape on each end of the bank link hole which makes a space available which will be filled with the spread head of the rivet. The reason we want the rivet head to fill this space is to prevent this new pin from coming out and to allow us to cut off (smooth off) the end flush with the bank link when we finish this job. This will give us a nice-looking job and without protruding rivet heads sticking out to catch on things. It is not always necessary to finish flush, but it looks nice. On some jobs, like certain clasp jobs, it is necessary for proper clearance.

MAKING A RIVET

A rivet is the rounding off or flattening the end of a pin. This increased diameter on each end of this pin is what holds it in place. Figure 6a shows a pin which we cut to a length slightly longer than the band width, Figure 6b. (Assortments of brass for yellow and nickel for white can be purchased from our jewelers supply house.)

To form a rivet takes a little practice, but eventually it becomes easy. If it's your first attempt, don't give up.

Figure 7 shows the items needed. A small watchmakers hammer (d) is used to form our rivet. Pliers or tweezers (not shown) can be used to hold the pin (a) upright over the anvil (b). Note: we are going to form the rivet on one end BEFORE we place this pin into the band link. We could form both rivets with the band links in place, but we chose this method today.

We actually form the rivet by hammering down on the end of the brass pin with light taps and by continually moving the hammer as we continue our light tapping. This takes some practice and the tendency is to use heavy strokes, but we should tap gently.

After the rivet is formed (or even partially formed on one side), we need to put the pin in the band link and finish by riveting the other side. Before we put this pin in this band link, we have a small problem. Because we decided to form one rivet (before assembling), we may have a small rivet (or bur) starting to form on the other end. If so, we need to cut this off so the pin will slide into place. If our pin is made long enough, it will be no problem to cut this end off and of course we will allow enough extra length on that end to form a nice rivet. As we said, it will take little practice but it's not hard to do. Figure 8 shows the pin (a) put into the hole in the band link and the rivet (that we made) is now at the bottom. We will now rivet the other end (which is the top side now). Then we cut off the excess top rivet and polish as needed to match the band finish.

HINTS FOR FUTURE JOBS

There are some jobs that may require some variations of the above procedures. They may not be watch bands, but just other repair jobs requiring a rivet. Sometimes for a larger rivet, we may want to use tubing instead of a solid rod. We can use our countersink bur as usual, but we can also use this countersink tool inside of the tubing material which will help to flange out the ends so we can form a nice rivet.

In all rivet jobs, we must tap, tap, tap many times with soft taps; otherwise, we may just bend the material. We are simply using the principle of "inertia". ❑

MILITARY TIME

MISCELLANEOUS MILITARY TYPE WRISTWATCHES

The following wristwatches saw service in World Wars I and II, and are identified by their captions (Figures 1 through 18).



Marvin E. Whitney
CMW, CMC, FAWI



Figure 1. Two views of Zenith 11½ ligne, 15-jewel wristwatch. Made for U.S. Signal Corps, World War I. Movement No. 2,355,451. Gilded movement, silver case with snap dust cover and bezel and hinged back. Porcelain dial with radium numerals 1-12, and red numerals 13-24 (AWI Orville R. Hagans Museum, Cincinnati, OH).







Figure 2. Belforte, Caliber 11-KIF, 7-jewel, shock-proof, one-piece olive green plastic case. Back stamped: U.S., Wristwatch (NON-Maintainable), FED. Stock No. 6645-952-3767, Mfg. Part No. 11K1185Q, Cont. No. DA-36-038-AMC 2030(W), Ser. No. 080756, Date MAR. 1965. The Belforte watch was handled by the Benrus Watch Company. Non-maintainable watches were not repaired; cost effectiveness dictated that they be discarded.





Figure 3. Benrus, Caliber DR2F2, 17-jewel, one-piece metal case with "hacking" device. Back engraved: Wristwatch DTU-2A/P, MIL-W-3818B, Mfr's. Part No. XZ73065, FED. Stock No. 6645-066-4279, U.S., Cont. No. SF6GY-V5185E-1F, Serial No. 079178, Date MAR. 1966.

Figure 4 (right). Benrus, Caliber 6Y1L3, 7-jewel, 10-½ ligne, general purpose wristwatch. One-piece olive green plastic case, two-piece stem, nonhacking. Nonrepairable. Dispose: radiation waste (Dr. G.W. Huckaba, Memphis, TN).







Figure 5. Benrus, Caliber GY1L2, 17 jewels, with "hacking" device, cased in one-piece metal case. Back stamped: Wristwatch, GGW113, FED. Stock No. 6645-066-4279, U.S., Mfg. Part No. XZ73065, Cont. No. GS-06S-7744, Serial No. 001814, Date MAR. 1973. Radioactive symbol on dial requires proper disposal of such watches (Fred C. Hougham, Daytona Beach, FL).



Figure 6. Benrus Caliber GY1L3, 7-jewel, one-piece olive green plastic case. Back stamped: Wristwatch, General Purpose, FED. Stock No. 6645-00-952-3767, Mfg. Part No. 1790, DSA400-74, DO273, Benrus, JUL. 1975, MIL-W-46374A, Dispose: RAD-Waste (Fred C. Hougham, Daytona Beach, FL).



Figure 7. Three views of Westclox Model D407, 7-jewel general purpose wristwatch. Movement made by Seiko (Japan). Nonhacking, shock-proof, one-piece olive green plastic case, two-piece stem. Nonrepairable. These types of watches were destroyed once they became inoperable (Dr. G. W. Huckaba, Memphis, TN).









Figure 8. Westclox Model 26-D, 7-jewel general purpose wristwatch. One-piece olive green plastic case. Two-piece stem. Nonrepairable. (Dr. G. W. Huckaba, Memphis, TN).

Figure 9. Westclox wristwatch, general purpose. Caliber Jeambrun's 26-D.





Figure 10 (above and right). Westclox wristwatch. The 17-jewel, Caliber 6602B movement was made by Japan's Seiko Watch Co. The nonhacking movement is housed in an olive green, one-piece plastic case. The movement is removed from the case by snapping or pulling out the claw-type crown/stem assembly and then lifting the crystal off with a crystal lift. The back of the case is engraved: Watch-Wrist, General Purpose, Mil. W-46374A, Westclox No. 75092, FSN 6645-952-3767, DAAR 25-70-D-0335, Sept. 1970, U.S. (Fred Hougham, Daytona Beach, FL).





Figure 10a. Westclox Model D407, 7-jewel, general purpose wristwatch. Movement made by Seiko (Fred C. Hougham, Daytona Beach, FL).



Figure 13 (right). Wittnauer, Caliber 11EW1, 7-jewel wristwatch fitted in a screwback water-resistant case. Ca. 1970 (William Plank, New Rochelle, NY).



Figure 11. Wittnauer's 7-jewel, Caliber 11X, U.S. Army wristwatch. Movement housed in a two-piece screwback water-resistant base metal case (William Plank, New Rochelle, NY).

Figure 12. Wittnauer Weems Caliber 10ESG second-setting watch with rotatable seconds bezel. 7 jewels. Ca. 1968 (William Plank, New Rochelle, NY).









Figure 14. These three photos show a Marathon 17-jewel, waterproof wristwatch made by Gallet (Swiss), Eta movement, Caliber No. 2801-2 CW4. Back of case is stamped: Wristwatch, GG-W-113, 6645-00-066-4279, 347, GSOWF 52875, Dec. '84, U.S. (Fred C. Hougham, Daytona Beach, FL).



Figure 15. Smiths of England's Model 66, 11¾ lignes, 17-jewel military wristwatch, movement No. 60466E, made for the RAF, Ca. 1967. The movement is fitted with "KIF" shockproof device, indirect drive sweep second mechanism and hacking device. The back of the case is stamped: WO/ 6645-99-961-4045, 0807/67, British Ordnance Property symbol ↑ (Fred C. Hougham, Daytona Beach, FL).



15



15



16



16

Figure 16 (above). Bulla German pilot wristwatch, Model AS1130 (A Schild-Swiss), 13 lignes, 15 jewels. The inside of the screwback is marked:

Boden Rostfre

LL

The nickel-plated case back is marked D700H (Fred C. Hougham, Daytona Beach, FL).





Figure 17. Glashutte–German military chronograph wristwatch, known as "Tutima," a style or model which was the first line of wristwatches completely made in Germany by Uhrenroh-Werke-Fabrik (Urofa) of Glashutte. The above chronograph watch, movement No. 210146, measured 15 lignes, 21 jewels, and was the last chronograph model wristwatch to be developed in Glashutte before World War II (Fred C. Hougham, Daytona Beach, FL).



Figure 18 (right) Quartz three-functions chronograph (date-time-chronograph). Back of case is stamped:

Stocker & Yale, Inc., Beverly, MA
NSN6645-01-087-1819
F4608-80-D-0107
80800 USA
3H
Shock & Water Resistant

The movement is housed in a two-piece metal case with snap back. Ca. 1980 (George T. Lewis, Seattle, Washington).

The Apprentice Clockmaker

Clock Movement Maintenance

Unit Repairs I

Mainspring Cleaning and Maintenance



JOHN P. KENYON
CMC

In the last article we learned how to dismantle a 30-hour time only movement. Now we will continue with the overhaul by focusing in on mainspring cleaning and maintenance. Keep in mind the safety measures to be observed when working with mainsprings, as referred to in the May '93 "Apprentice Clockmaker." Please take the time to review these precautions.

With the exception of the escapement, the mainspring is probably the most neglected component in a clock movement overhaul. All too often, mainspring maintenance consists of a douse in the ultrasonic tank, a dunk in the rinse solution, a few drops of oil, and then a hope for the best. In another scenario, the cleaning, rinse, and lubrication is performed while the mainspring is still restrained in a clamp. Sometimes there is no cleaning at all, just a few drops of oil added to the outside coils. It doesn't take a genius to realize that these methods are ineffective and that a mainspring must be clean, smooth, and properly lubricated to function properly. After all, it is the power source for the entire mechanism.

In a previous installment we discussed how to immobilize the mainspring and dismantle the movement. We then removed the mainspring, arbor, and main wheel from the back plate as a unit. Now the mainspring must be prepared for cleaning by removing it from the arbor after safely removing the mainspring clamp.

REMOVING THE MAINSPRING CLAMP

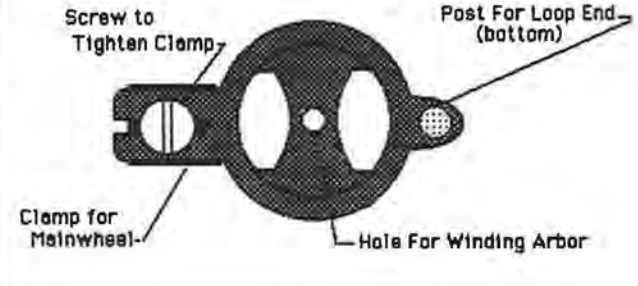
When the mainspring was let down into the restraining clamp, all power was immobilized. Now it is time to remove the mainspring clamp so the mainspring can relax completely. This is accomplished by winding the mainspring with a mainspring winder, enough so that the restraining clamp can be removed, then carefully unwinding the mainspring completely. For this operation a mainspring winder is a must. The supply catalogs list an inexpensive but adequate winder (less than $10) for loop-end mainsprings as illustrated in Figure 1. More sophisticated mainspring winders can also be used with proper attachments. When using the mainspring winder illustrated, a let down tool is used for winding and unwinding.

REMOVING THE MAINSPRING FROM THE ARBOR

Now that all power is removed from the mainspring and it is completely relaxed, it must be removed from the arbor. This can be aggravating, especially if the inner coils are badly "set." One method that works well is outlined below:

1. Turn the wheel-arbor-mainspring assembly so that the winding arbor is pointing down.
2. Clamp the winding square in a bench vise.
3. Turn the mainspring opposite to the direction of winding until substantial resistance is realized.
4. While holding the reverse tension with one hand, insert a small screwdriver blade between the arbor and the inner-coil of the mainspring.
5. Carefully manipulate the screwdriver blade until the mainspring hole slides clear of the arbor hook.

Figure 1. Loop-end mainspring winder



6. Lift the mainspring away from the main wheel and off from the arbor.

CLEANING A MAINSPRING

An approved method for cleaning a loop-end mainspring is summarized:

1. Place a sturdy nail or peg in the loop. The head must be large enough to prevent the loop from sliding over it.
2. Clamp the nail or peg in a bench vise with the head on the outside so that the end of the mainspring cannot slide off.
3. Pass a wooden dowel pin through the center coil and carefully pull the mainspring straight out until two or three coils remain.
4. Set the dowel pin in a pre-drilled hole (drilled every 4") along the edge of the bench or table.
5. Clean the mainspring end-to-end on both surfaces by wiping it carefully with a lint-free cloth or chamois that is dampened with clock cleaning solution.
6. Follow with a rinse solution using this same procedure.
7. Dry the rinse solution with a hair dryer on low heat.
8. In a similar manner, polish the mainspring with fine steel wool, then wipe it clean with a lint free cloth.

Try not to distort the shape of the mainspring. Center coils can be done by "fishing" through a piece of treated cloth or chamois. Always use rubber or plastic gloves and protective eye wear to prevent severe chemical burns or allergic reactions. Also, **be careful and alert** at all times. A mainspring is unpredictable and can cause serious injury to yourself or to someone nearby if mishandled.

INSPECTION

There is no need to replace a mainspring because of age alone. Loop-end mainsprings are usually found to be in good condition, provided they have been properly cared for in the past. There is no "cut and dry" rule for checking the tension of a mainspring. It's one of those things that is learned through experience. It will suffice to say that if it remains with the coils together when completely relaxed (rather than springing out), it is probably "set" and should be replaced. It would be a good idea to compare your opinion with that of an experienced clockmaker. The surface of the mainspring should be checked for rust, pits, nicks, or roughness that is not removed in the cleaning, polishing process. If any of these defects are found, replace the mainspring.

LUBRICATION

Lubricate lightly with a good mainspring lubricant by applying the lubricant to a chamois or a lint-free cloth and drawing it the length of the mainspring and through the center coils. Do not wait until the clock is assembled to lubricate the mainspring by adding a few drops of oil to the outer coils. This practice results in an allocation of too much oil in some places and none in others.

WINDING THE MAINSPRING BACK INTO A RESTRAINING CLAMP

After lubrication, reshape the inner coil so that the mainspring hole will catch on the arbor. You may need to use the release procedure in reverse to accomplish this, or the arbor hook may just slip into place. Generally, it is easier to install the arbor than it is to take it apart. Be sure to install the mainspring in the right direction. Use the winder to wind the mainspring far enough to fit inside the restraining clamp. You may need an extra hand here as a guide, because mainsprings tend to "ball up" when passing through some of the preliminary coils. When the clamp can be positioned over the mainspring, use the let down tool to carefully release it into the clamp.

STORAGE

Now that the mainspring is cleaned, polished, inspected, oiled, and installed back on the arbor, store it in a clean plastic container (an oleo carton will do) until you are ready to assemble the clock.

Next time we will learn how to inspect and repair damaged and worn pivots. ❑

KEY TEST FOR QUARTZ WATCHES

The "KEY TEST FOR QUARTZ WATCHES" by Ewell Hartman, CMW is a quick and simple method of locating the problem in a quartz analog movement. The only tool required is a meter.

Material and instructions for learning this test are supplied by the AWI-ELM Trust as part of their educational work. There is no charge to any group wishing to learn this test. There are great benefits to learning this in a group setting. However, for individuals who may not be able to participate in a group, it is available to them also.

For more information call or write the AWI office for an information sheet and application form. ❑

Project Extend Update

By James Lubic
Manager of Education & Technical Services

1994 will be the fourth year of Project Extend's existence. Like most, we like to improve with age. In the past three years we have learned a lot about what the members want and what their needs are. We have updated the course content in some classes, added classes, and deleted other complete courses.

This month we are publishing the re-aligned roster of Project Extend courses for 1994. As in previous years, number I was thought to be easier than II, and number III courses were the next logical step, and so forth. One should not make the assumption that because Quartz I, II, & III are offered in sequence, they can take Quartz I and II in succession and be prepared for the CMEW exam offered in Quartz III. Quartz I is meant to be taken by members who have previous experience with mechanical watches. They learn how to read VOM properly and how electronics work in quartz watches. One should not go from Quartz I into Quartz II (the advanced course the following week). The student should go back to work and practice what they learned in Quartz I. The next time Quartz II is offered, they should be ready to participate in the course, and then maybe stay the following week for Quartz III and the exam. The point is that three weeks of training doesn't make a Certified Master Electronic Watchmaker.

The same is true with the watch and clock courses. Some courses taken back-to-back does make good sense, such as Watch II & III, Clock I & II, Clock II & III, or Clock III & IV.

If you have any questions about courses that you would like to take back-to-back, or otherwise, please call or write AWI Central. We will do our best to advise you. ❑

PROJECT EXTEND CLASS RE-ALIGNMENT

Watch I *(formerly #VI)*	American Pocket Watches	A. Carpenter
Watch II *(formerly #I)*	Staffing & Lever Escapement	J. Lubic
Watch III *(formerly #II)*	Hairspring Vibrating & Timing Adjustments	J. Lubic
Watch IV *(formerly #III)*	Calendar, Automatic, Stop Watch & Chronos	J. Lubic
Watch V *(same)*	Watch Restoration	R. DeCorte
Watch VI *(formerly #IV)*	Introduction to Complicated Watches	A. Simonin
Watch VII *(new)*	Clock-watches & Perpetual Calendars	P.DuFour
Watch VIII *(formerly #VII)*	CMW Review & Exam	J. Lubic
Quartz I *(same)*	Meter Reading, etc.	G. Jaeger
Quartz II *(same)*	Advanced Quartz	B. Bishop
Quartz III *(same)*	CMEW Review & Exam	A. Carpenter
Clock I *(same)*	Beginning Clock Repair	J. LaChapelle
Clock II *(formerly #VI)*	Chiming & Striking Mechanism	J. Nagle
Clock III *(new)*	Clock Escapements	J. Nagle
Clock IV *(formerly #II)*	Advanced Clocks	R. Iverson
Clock V *(formerly #III)*	Clock Restoration	D. Christianson
Clock VI *(formerly #IV)*	Clock Repairing Operations	J. Nagle
Clock VII *(formerly #V)*	CMC Prep	D. Christianson
Beginning Horology *(new)*		J. Lubic
The Lathe Course *(12 days, 1 complete course)*		R. Hovey
Clock Case Repair *(same)*		J. Williams
Watch Case Repair *(same)*		M. Richmond
Basic Jewelry Repair *(same)*		M. Richmond

AWI BENCH COURSES

To register for these courses, please send with your request a registration fee of **$35** per instruction day (for AWI members) to: **AWI Central, 3700 Harrison Ave., P.O. Box 11011, Cincinnati, OH 45211.**

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18-19--Repair of the Atmos Clock--New Orleans, LA
18-19--Hairspring Vibrating--Pittsburgh, PA
18-19--Cuckoo Clock Repair--Indianapolis, IN*
19-20--400-Day Clock Repair--Tucson, AZ*
19-20--Mechanical Chronographs--Tucson, AZ*

OCTOBER 1993
16-17--Hairspring Vibrating--Denver, CO
22-25--Cross Slide/Arbors & Stems--New York, NY
24--Servicing ETA Quartz Chronographs--Austin, TX
29--Basic Pocket Watch--W. Palm Beach, FL
30-31--Repair of the Atmos Clock--Arlington, TX
30-31--Cuckoo Clock Repair--Minneapolis/St. Paul, MN

NOVEMBER 1993
6-7--Striking Clocks--Salt Lake City, UT
13-14--Hairspring Vibrating--Austin, TX

JANUARY 1994
15-16--Hairspring Vibrating--Baltimore, MD
21-23--Mid-Year Meeting & Regional--Anaheim, CA

FEBRUARY 1994
4-7--Lathe Course (Phase 3)--Orange County, CA
19--Servicing ETA Quartz Chronographs--Phoenix, AZ*
19-21--Advanced Clock Repair--Phoenix, AZ*

MARCH 1994
12-13--Repair of the Atmos Clock--Orlando, FL
12-13--400-Day Clock Repair--Salt Lake City, UT
19-20--Advanced Quartz Watch Repair--Birmingham, AL
20--Introduction to Quartz Watch Repair--NY
20--Basic Pocket Watch--Sacramento, CA

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James Williams, CC
400-Day Clock Repair
Striking Clocks
John Nagle
Servicing ETA Quartz Chronographs
James Broughton, CMEW, FAWI
The Lathe Course
Roy Hovey
Hairspring Vibrating
Joseph Cerullo, CMW, CMC
Modern Mechanical Chronographs
Remy Waelchli

APRIL 1994
8-10--Mechanical Watch Repair--Sacramento, CA
9-10--Cuckoo Clock Repair--Baltimore, MD
9-10--Modern Mechanical Chronographs--Orlando, FL
15-18--Lathe Course (Phase 3)--New York, NY

MAY 1994
15--Servicing ETA Quartz Chronographs--Birmingham, AL
21-22--Advanced Quartz Watch Repair--NY
21-22--Introduction to Clock Repair--Boston, MA

JUNE 1994
4-5--Hairspring Vibrating--Des Moines, IA
5-Servicing ETA Quartz Chronographs--Orlando, FL

*In conjunction with a convention

PROJECT EXTEND CLASSES 1993-94

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13-17--Watch Case Repair--M. Richmond
20-24--Clock I--J. LaChapelle
27-Oct.1--Clock II--J. Nagle

OCTOBER 1993
4-8--Clock IV--R. Iverson
11-15--Clock Case Repair--J. Williams
18-22--Clock VII--D. Christianson

FEBRUARY 1994
7-11--Quartz I--G. Jaeger
14-18--Quartz II--R. Bishop
21-25--Quartz III--A. Carpenter
Feb. 28-Mar. 4--Watch I--A. Carpenter

MARCH 1994
7-19--Lathe Courses--R. Hovey
21-25--Clock Case Repair--J. Williams

APRIL 1994
18-22--Watch II--J. Lubic
25-29--Watch III--J. Lubic

MAY 1994
2-6--Clock I--J. LaChapelle
9-13--Clock II--J. Nagle
16-20--Clock III--J. Nagle
23-27--Clock IV--R. Iverson

JUNE 1994
6-10--Clock V--D. Christianson
13-17--Watch V--R. DeCorte

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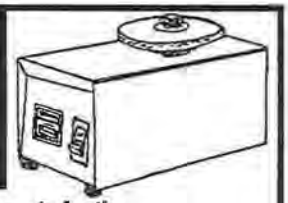
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SEPTEMBER 1993

17-19–Advanced Clock Repair Bench Course (AWI); Roland Iverson, instructor; Des Moines, IA.*

17-20–Cross Slide Lathe Bench Course (AWI); Roy Hovey, instructor; Orange County, CA.*

17-20–Taipei International Jewelry and Timepiece Show, Taipei World Trade Center. For information call (312) 819-7373.

18–Arizona Watchmakers, Clockmakers & Jewelers Annual Convention; Best Western Inn-Airport, Tucson, AZ.

18-19–Repair of the Atmos Clock Bench Course (AWI); Gerald Jaeger, instructor; New Orleans, LA.*

18-19–Hairspring Vibrating Bench Course (AWI); Joseph Cerullo, instructor; Pittsburgh, PA.*

18-19–Cuckoo Clock Repair Bench Course (AWI); James Williams, instructor; Indianapolis, IN.* Held in conjunction with the Horological Association of Indiana Fall Meeting & Workshop.

18-19–Horological Association of Indiana Annual Meeting & Fall Workshop, Indianapolis Motor Speedway Motel, Indianapolis, IN. For more information: Sally Jo Alexander, 208 Alcott Road, Louisville, KY 40207.

19-20–Mechanical Chronographs Bench Course (AWI); James Lubic, instructor; Tucson, AZ.* Held in conjunction with the Arizona Watchmakers, Clockmakers & Jewelers Annual Convention.

19-20–400-Day Clock Repair Bench Course (AWI); John Nagle, instructor; Tucson, AZ.* Held in conjunction with the Arizona Watchmakers, Clockmakers & Jewelers Annual Convention.

OCTOBER 1993

1-3–New York Watchmakers Association Convention, Holiday Inn, Seneca Falls-Waterloo, NY.

8-10–Illinois State Watchmakers Convention; Clock Tower Inn; Rockford, IL. For more information contact: Jack Donovan, 124 North St., Normal, IL 61761.

10–Watchmakers Association of Ohio Auction, 12 Noon, American Legion Hall, Southway Post 144, 3253 South High St., Columbus, OH. For more information contact Karl Farnlacher (513) 275-3172.

16-17–Hairspring Vibrating Bench Course (AWI); Joseph Cerullo, instructor; Denver, CO.*

22-25–Cross Slide/Arbors & Stems Bench Course (AWI); Roy Hovey, instructor; New York, NY.*

24–Servicing ETA Quartz Chronographs Bench Course (AWI); James Broughton, instructor; Austin, TX.*

25-29--Minute Repeaters--Clock (Sonnerie) Watches and the Instantaneous Perpetual Calendar, Philippe DuFour, instructor, Project Extend Education Center, Cincinnati, OH.*

29-31–Florida State Watchmakers Association Convention, Ramada Hotel Resort, West Palm Beach, FL.

30-31–Repair of the Atmos Clock Bench Course (AWI); Gerald Jaeger, instructor; Arlington, TX.*

30-31–Cuckoo Clock Repair Bench Course (AWI); James Williams, instructor; Minneapolis/St. Paul, MN.*

NOVEMBER 1993

6-7–Striking Clocks Bench Course (AWI); John Nagle, instructor; Salt Lake City, UT.*

13-14–Hairspring Vibrating Bench Course (AWI); Joseph Cerullo, instructor; Austin, TX.*

JANUARY 1994

15-16–Hairspring Vibrating Bench Course (AWI); Joseph Cerullo, instructor; Baltimore, MD.*

21-23–AWI Board of Directors Mid-Year Meeting & Regional, Anaheim, CA.

FEBRUARY 1994

4-7–Lathe Bench Course, Phase 3 (AWI); Roy Hovey, instructor; Orange County, CA.*

19–Servicing ETA Quartz Chronographs Bench Course (AWI); James Broughton, instructor; Phoenix, AZ.* Held in conjunction with the Arizona Clockmakers & Watchmakers Guild Annual Convention.

19-21–Advanced Clock Repair Bench Course (AWI); Roland Iverson, instructor; Phoenix, AZ.* Held in conjunction with the Arizona Clockmakers & Watchmakers Guild Annual Convention.

MARCH 1994

12-13–Repair of the Atmos Clock Bench Course (AWI); Gerald Jaeger, instructor; Orlando, FL.*

12-13–400-Day Clock Repair Bench Course (AWI); John Nagle, instructor; Salt Lake City, UT.*

19-20–Advanced Quartz Watch Repair Bench Course (AWI); Robert Bishop, instructor; Birmingham, AL.*

20–Introduction to Quartz Watch Repair Bench Course (AWI); Buddy Carpenter, instructor; New York.*

20–Basic Pocket Watch Bench Course (AWI); Alice Carpenter, instructor; Sacramento, CA.*

APRIL 1994

8-10--Mechanical Watch Repair Bench Course (AWI); James Lubic, instructor; Sacramento, CA.*

9-10–Cuckoo Clock Repair Bench Course (AWI); James Williams, instructor; Baltimore, MD.*

9-10–Modern Mechanical Chronograph Bench Course (AWI); Remy Waelchli, instructor; Orlando, FL.*

15-18–Lathe Bench Course, Phase 3 (AWI); Roy Hovey, instructor; New York, NY.*

***For more information on AWI Bench Courses, Project Extend, and Regional Seminars, contact AWI Central, P.O. Box 11011, 3700 Harrison Avenue, Cincinnati, OH 45211; (513) 661-3838; Fax (513) 661-3131.**

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