

HOROLOGICALTM TIMES

May 2001



American Watchmakers-Clockmakers Institute

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COVER

This month's cover features
"boules"—the beginning of jewels.



President's Message

Ron DeCorte, CMW

For the past few years there has been growing concern within the membership regarding the availability of spare parts, especially in the watch sector. I would like to address this issue in a very direct manner and attempt to shed some light on the subject, putting some old rumors to rest.

I would also like to point out that I am not an attorney and that the content of this letter is not to be taken as legal advice. Instead it is my personal observations of the subject and is meant only to inform the membership, to the best of my abilities, of what I have discovered.

As you may or may not know there are companies that will sell you everything you might need to service one of their horological products and there are other companies that will not. At first glance this may seem to be a contradiction and that someone is breaking the rules. But first we need to examine what are the rules ...

After conferring with several attorneys, at least one who is an expert in this area of law, several things started to become clear. Any company that produces a product also has the right to protect that product, and their reputation, by being selective in regard to who receives the spare parts that are necessary to service their product(s). You might argue that if a customer buys a particular product they, the purchaser, has the right to decide who will service that item, but in reality the law seems to say differently.

However, if a person who services a product and has an account to purchase parts for that product is suddenly, and for no apparent reason, refused these parts, they may have recourse. But this recourse is complicated and would need to be addressed through that person's legal counsel within a limited time frame.

As the number of watches being produced continues to grow, the need for qualified professionals to service these products will also need to expand. Presently AWI is working with industry in an attempt to rectify the shortage of watchmakers and improving the level of training to meet current and future needs. The combination of a standardized curriculum for the watchmaking schools, improved training for existing watchmakers, and a strong certification program will be beneficial to our profession as a whole.

So how does an AWI member gain access to the spare parts for horological products that he/she might want to service? Personally I would suggest writing to the particular company and explaining your professional qualifications such as training, years of experience in the trade, certification, and even a list of equipment. The results may vary according to the individual and from company to company, but show your professionalism and be persistent.

The bottom line is that if we expect to be treated as professionals we must present ourselves as professionals, both personally and as an organization. We shouldn't expect a company to trust us with their product and reputation if we aren't willing to extend ourselves to meet modern professional standards.



Executive Director's Message

James E. Lubic, CMW

I hope you found the AWI mailbag that was included with this month's issue of the *HT*. This is the second year that the AWI-ELM Trust (Education, Library, and Museum Trust) has provided these for your convenience. Our hope is that you will fill these bags with the expired silver oxide batteries that you accumulate in your shop and send them to the Institute. Every year the ELM Trust collects these batteries from AWI members and turns them into money for educating students in our trade. The more batteries we collect the more money the Trust has for assisting members with grants for attending the Institute's Continuing Education

Programs and scholarships for full-time student training. Our goal is to reach 1,000 pounds or more this year. In the past we have collected around 900 pounds. If you need more bags please call our toll free number (866-367-2924) and request them. Your generosity is also tax deductible, as the ELM Trust is an IRS 501 (c) 3 charitable organization.

I have just returned from the New Orleans roundtable meeting that I had mentioned in my message last month. This meeting was sponsored by the Federation of the Swiss Watch Industry and was attended by the North American watchmaking schools and members of the watchmaking industry.

I won't go into a lot of detail as we will most likely publish a full report in next month's issue, but I can say that the meetings were very upbeat and positive. As stated last month, our goal is to work with WOSTEP to develop a two-tier curriculum that can be implemented in all the watchmaking schools in North America. This would help to standardize the curriculums throughout North America. Everyone in attendance agreed that this should be our goal. We hope to receive positive news from WOSTEP by mid-May concerning this approach to educating watchmakers in North America.

Since late February we have had 165 members participate in our "Bench Course Survey" via our website. I have just started to receive faxed copies of this survey from last month's issue. If you don't have access to the internet or a fax machine you may still participate by mailing your survey to the Institute (see page 46 of this month's issue for a copy of the survey). I look forward to using this information on a continuing basis to identify locations of interest to organize our Bench Courses. I plan to report on the initial results of these surveys in next month's *HT*.

Be sure to consult our latest schedule of Continuing Education Clock Courses. We have some new programs that I think will be very interesting. One is "Servicing Tower Clocks" with tower clock expert, Lloyd Larish. Another is "Restoring a Riefler Clock" from the Cincinnati Observatory with Laurie Penman.

We are also in the process of developing a program to present at this year's JA New York Show, July 29 – August 1, 2001. I will have more details next month on how you can attend this free presentation.



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Questions & Answers

Question

I have been unable to find any information on this watch.

The case is 18K, O.F. marked 18 carat fine on the inside of the back cover. Inside the dust cover is the mark of Andrew K Shiebler & Son, American Watch Case Co., 15 Maiden Lane, New York. No more information. On the dust cover is engraved, E.C. Messick, Shelbyville, Ind. 1897.

The dial is very good porcelain with red numbers at the 5 minute markers on a chapter ring, fine Arabic numbers with excellent yellow filigree hands.

The movement is very high grade 21V 16s with three case screws which the match marks on the case.

The name Jules Monard, Geneva appears on both plates and dial. The only other marks are adjusted and serial no. 24771 on both plates.

The jewels are red. Information on Jules Monard would be very helpful but I would like all information you



can find on the movement. I am aware AWI does not give values but will you advise, if any, rarity.

*E.M. Lewis,
Indianapolis, IN*

Answer

Your pocket watch is a very high grade watch, indeed; both the case and its precision movement. The movement is highly polished, adjusted to temperature and 6 positions; jeweled in all the right places and has a swan-neck regulator arm and micro-regulator cam for precise, fine rating adjustment.

Jules Monard of Geneva made not only high grade watches like yours, but also highly complicated high grade watches like repeaters and grande sonneries during the late 19th and early 20th century.

A. Wittnauer was the sole importer of Jules Monard watches in the US in 1898 and continued, with others, to import them early in the 20th century.

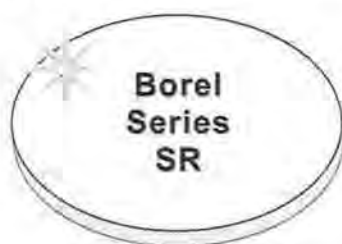
Yours, I would judge, was made in 1900. It is a fine example of exceptional Swiss precision watchmaking, standing shoulder-to-shoulder with other honored names of that era such as Patek Philippe, Henry Capt, Meylan, Agassiz, and Vacheron & Constantin.

*David A. Christianson,
Technical Editor*



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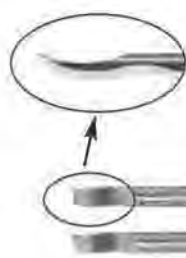


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Ask Huck

Lathe and Bench Considerations

Question

What is a good lathe bench and how should I secure the watchmakers lathe to the bench?

Answer

This is the most difficult question I have ever received. No matter what I recommend, it will not be right for all people.

In more than a half-century, I have drilled holes in the bench top, screwed lathes to the bench, and used stand-alone lathe bases. In most instances, I hated myself for those decisions.

The lathe I use most is a Moseley style Boley that is about 90 years old. It sits on a Borel stand-alone base which also supports the motor. Spindle height is 6¼ inches above the bench top. My bench is 34½ inches high and I sit on a stool 22 inches high. These items fit my stature and my vision. A motor switch is on the Borel base. I have used this arrangement for about 30 years. When not in use, I sit the lathe away from the bench.

Now, let me make a recommendation: Choose a combination that will be completely comfortable for long periods of work. Avoid working conditions that distract your mind from the task at hand.

A great merit to a stand-alone lathe is that it can be positioned for easy access to tools, your hands, and vision. I often do faceplate work looking into the right end of the lathe, the motor in reverse, and my right hand and graver working between the motor and lathe bed. I'm looking straight into the faceplate. I like the stand-alone setup.

Question

What is the lathe drive belt you like best? Why?

Answer

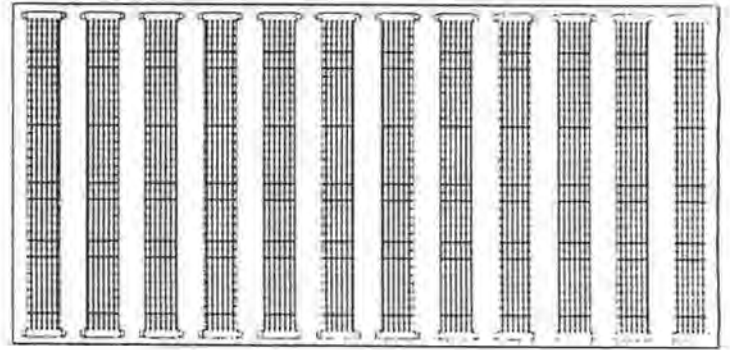
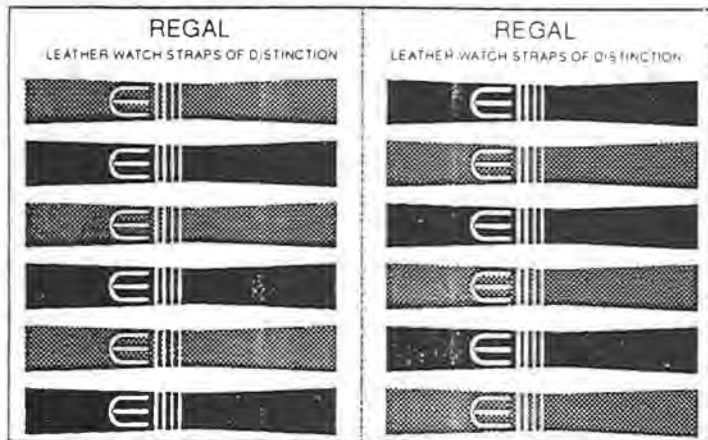
Lathe belts are always a problem. For serious lathe work, the belt needs to be lightweight, strong, non-elastic, smooth running, and easy to make a good joint splice. I've never had a belt that meets that criteria.

My lathe on the Borel base has a 9-inch shaft-to-shaft distance. The motor's top speed is around 2800 RPM, and uses a pulley diameter of 1½ inch. The belt is an oil-soaked leather boot lace spliced with a small hook made from a paper clip. It functions equally well, and better than most of the many belts I've used over 60-plus years. ☺

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Kari Halme

Making Jewels

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History of Jewels

The main function of watch jewels is to act as bearings inside which pivots turn. A jewel bearing minimizes friction, and it holds oil better than metal bearings. Other jewels are cap jewels which limit endshakes of wheels, roller stones, pallet stones and ball bearings in rotors of some watches. Other applications are electrical insulators and, for example, the round jewel disk found in Rolex's calendar mechanism.

The first watch bearings were simple holes drilled in the plates or the bridges, or an inserted brass bushing. With time, dust found its way into the oilsinks. The dust mixed with oil soon became a grinding paste which ate away brass quickly. Wear hit the steel pivots, too. Worn, oval pivot holes and grooved pivots made watchmakers start searching for harder bearing materials. This eventually led to the manufacturing of watch jewels.

The history of watch jewels began in 1700 (or in 1702, according to some sources) when a Swiss optician and astronomer, Nicholas Fatio de Duillier discovered that he could drill a hole in a natural jewel with diamond powder. He was born in Basel in 1664, but he grew up in Geneva where he became a burgher in 1678.

Fatio de Duillier chose ruby as the material, since it was the hardest known stone after the diamond. He convinced French watchmakers, Peter and Thomas De Beaufré, of the brilliance of his invention. So the De Beaufrés built the first watch with ruby bearings, and Fatio de Duillier got his invention patented in 1704. Geneva was the center of watchmaking at the time, but all the Swiss cared about was the decorative appearance of the timepieces, and Fatio de Duillier could not sell his invention in Switzerland.

Both the British and the French were always looking for ways to improve the accuracy of measuring time. So Fatio de Duillier moved to England where his invention was

warmly received and quickly put into use. The jewels used as bearings were not good enough for jewelry, but they proved to be very valuable in watches because they lasted practically forever. However, production methods were extremely slow and required much labor. Therefore, the jewel bearings were only installed in the most expensive watches. The manufacturing methods and the use of jewel bearings remained a big secret for a long time which gave the British a huge advantage.

The British were practically the only users of jewel bearings until about 1810. A small number of jewels found their way to France earlier. For example Abraham Louis Breguet got his jewels from his friend John Arnold. Their friendship was so strong that jewels crossed the border even when France and England were officially at war with each other. In 1825 a Swiss, Ingold, went to Paris to study the jeweler's craft. He shared his knowledge after returning to Switzerland. One of his students opened the first Swiss jewelmakers' and sellers' workshop in the Principality of Neuchâtel. From 1850 on, jewelring of watches became a general practice in Switzerland.

The jewels were first shaped with simple hand tools, but the industrial revolution during the second half of the 19th century brought machines into jewel workshops. This standardized the appearance and manufacturing accuracy of the jewels. The only thing that slowed down their use was the high price of clean and flawless natural stones.

A French professor at Paris Conservatoire des Arts et Métiers (the Conservatory of Arts and Crafts in Paris), Auguste Verneuil, invented a process of manufacturing fine synthetic jewels in 1892. However, it took almost another twenty years before the industrial method of making artificial jewels was perfected. Although the material for both, natural and artificial jewels, is the same aluminum oxide, natural stones have color differences, impurities and pores. Verneuil's invention enabled the

manufacturing of homogeneous, fully or almost pure and durable jewels which were also substantially less expensive than natural ones. This led to mass production; thus we can think, as a rule of thumb, that watches made before the 1900s have natural jewel bearings.

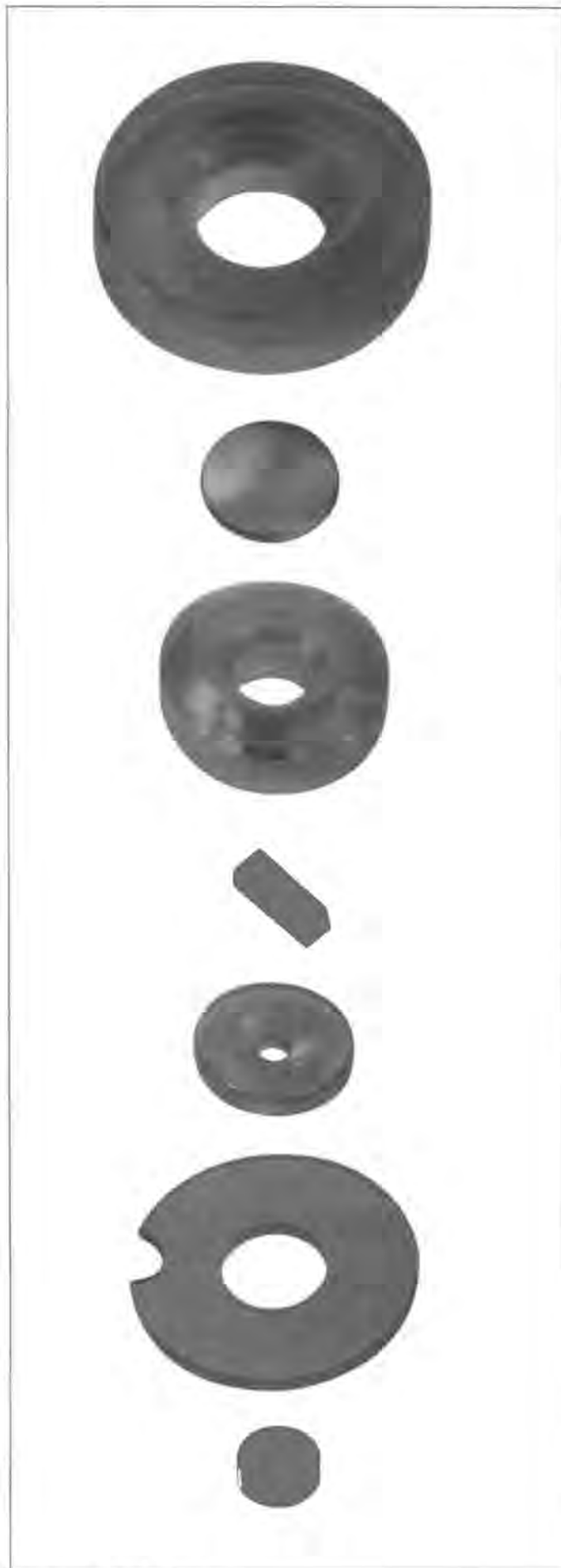
In the 1970s there were still about 20 watch jewel manufacturers in Switzerland. Today one major manufacturer and some smaller factories remain. The biggest is Comadur S.A. which is a part of the Swatch Group. The jewel manufacturers' organization in Bienne is called Association suisse des fabricants de pierres d'horlogerie (ASFPH, founded in 1898). Amongst other watch jewel-making countries are China, Italy, Japan, and France.

From Powder to Jewel

The earliest jewel bearings were natural rubies. Some watches even had diamonds as cap jewels. In many old pieces the jewel in the balance bridge is not a cap jewel but merely a stone ornament. Modern watch jewels are synthetic rubies (or sapphires). Their life begins when red bauxite is chemically turned to aluminum ammonium double sulfite, also known as ammonia alum. Bauxite is the main ingredient of industrial aluminum, and it consists of impure aluminum and hydroxides. Ammonia alum is a liquid which is purified and then cooled and dried.

Dry alum is calcinated, in other words, it's oxidized by burning it into ashes at about 1000° C (1800° F). Calcinated alum is brittle and it is crushed into powdery crystals about one micron (0.001 mm = 0.00004") in diameter. The crushed crystals form extremely pure, very fine and translucent corundum powder, also known as aluminum oxide. The color of this powder can be changed by adding metallic oxides to the alum before it is being calcinated. Thus the color is no indication of the hardness of a jewel, since all jewels are made of the same basic ingredients. Rubies, for example, get their color from chromium oxide.

The next step is called flame fusion which is still done the way Mr. Verneuil intended. The top part of the Verneuil furnace is a round cylinder into which the aluminum oxide is poured. Through the cylinder runs an axle which carries a fine sieve at its lower end. On top of the cylinder there is a mechanical hammer which taps the axle. At each tap of the hammer, the sieve allows small quantities of aluminum oxide to sift down into a funnel under the cylinder. Oxygen passes through the upper part of the chamber carrying the aluminum oxide down into a tube. In the tube, pure hydrogen (produced by electrolysis) is added to the down flowing powder. When hydrogen is mixed with oxygen and ignited, it produces temperatures in excess of 2050° C (over 3690° F), which is needed for the fusion of highly purified aluminum. The end of the tube forms a nozzle of the burner.



Different Watch Jewels

The glowing burner melts the powder passing by, and the fused particles fall as droplets onto a table placed underneath. On the table there is an oriented seed crystal which guides the crystals of the droplets into a desired direction. The table is surrounded by an insulating sleeve made of fire clay. This sleeve, called a crucible, maintains a constant temperature which is necessary. The crucible has a small opening which allows an operator to observe the growth of the raw jewel. The end result is a boule, a pear-shaped, solid stone cylinder. This is the material for all watch jewels. Manufacturing principles of different jewels are the same, no matter which the final shape is. Thus I will concentrate only on the most common one, the jewel bearing.

Birth of a Jewel Bearing

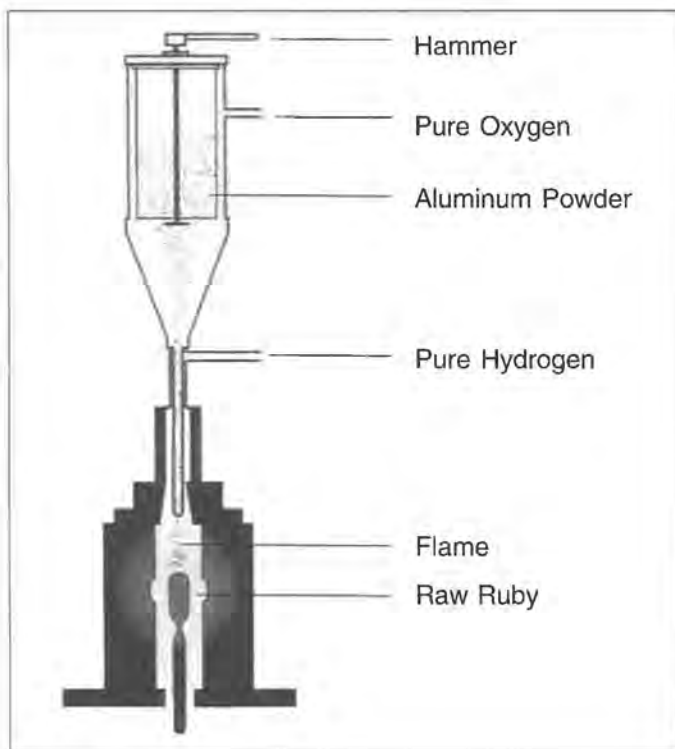
The boules are first split lengthwise into two parts. The halves are attached to wood blocks with shellac, the cut surfaces facing the blocks. The halves are cut into half moons of a given thickness (0.3-0.5 mm). The half moons are then cut into squares. All the cuts are done at a precise angle in relation to the optical axis of the crystal which is determined with polarized light. A cut to a wrong direction will break the boule into thousands of useless pieces. The cutting is done with a copper disk that is covered with a layer of diamond powder.

The squares are cemented into long four-cornered rods which are fed between two metal drums. The drums will round off the corners, and the result is tiny round plates, known as blanks.

The next step is drilling the holes. The traditional way is to use a thin steel wire coated with diamond paste. The wire turns at the rate of 20,000 revolutions per minute. The modern way is to use a laser beam. At this stage the hole can still be off-center.

Laser drilling is many times faster and more accurate than the older methods. Mechanically drilling a hole is born every 30 seconds, but a laser beam can cut about 150,000 holes within the same time! The only disadvantage of the laser is that it burns the wall of the hole which must be finished at a later time. Finishing enlarges the hole about 0.02 mm. The smallest laser-drilled hole diameter is 0.04 mm which becomes 0.06 mm after finishing.

The drilled jewels are threaded onto a steel wire which is over one meter long. The wire can hold up to 10,000 jewels, depending on the size of the jewels. The jewel chain is sealed with shellac or a metal alloy with a low fusion point into a shuttle which is a part of a multi-



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Different Solid and Split Boules

spindle machine. The enlarging happens when the machine moves the jewels from one end of the wire to the other while diamond powder mixed with oil is poured onto the wire.

The wire is then replaced with another one, and the jewels are pushed by a rubber coated roller against a diamond grinding wheel. The grinding machine vibrates the jewels to and fro until they reach the same desired outside diameter. Normal manufacturing accuracy for Swiss jewels is 0.003 mm.

The oilsink is cut on another machine with diamond cutters. Recessing and checking of the cut are done automatically. After the recessing, the jewels are cemented onto iron plates covered with shellac. The plates are heated until all the jewels lie flat and leveled against the plates. The top surface of the jewels is ground with diamond paste on a grinding wheel. Then they are polished with brushes of various kinds (metal, horsehair, etc.) and diamond paste. After the top sides are finished, the jewels are removed and turned over, ready for finishing the bottoms.

The second finishing determines the final height of the jewels. The jewel shape can be altered with different brushes and grinding/polishing settings. The majority of the jewel bearing holes are cylindrical, but the balance hole jewels and regular hole jewels of high-quality watches have holes which have been rounded up towards the



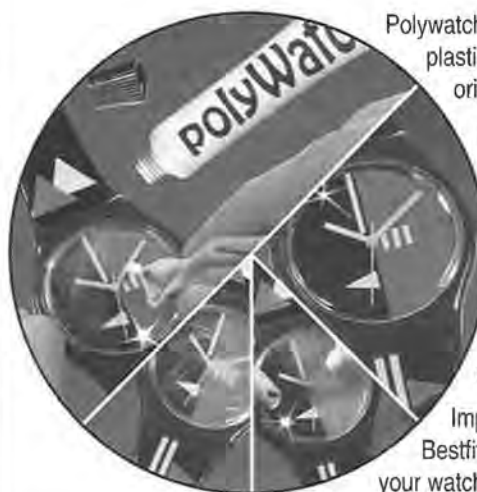
Stages of Pre-Cutting: Half Moons, Squares, and Round Disks

outside of the jewels. A curved hole wall decreases the functional bearing surface which reduces friction. This curving is known as olive cutting which is done with a steel wire and diamond paste. The word olive is of French origin and means rounding up.

The jewels are carefully cleaned and checked after each operation. Bad quality jewels are eliminated at each stage. The final inspection is done with a microscope and a human eye. About 10% of the jewels make it from beginning to the end. The disqualified jewels cannot be recycled, but eccentric holes can be enlarged to the next size.

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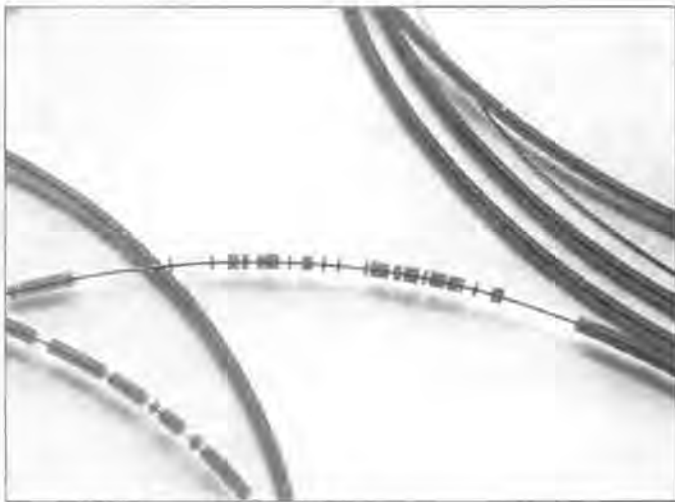
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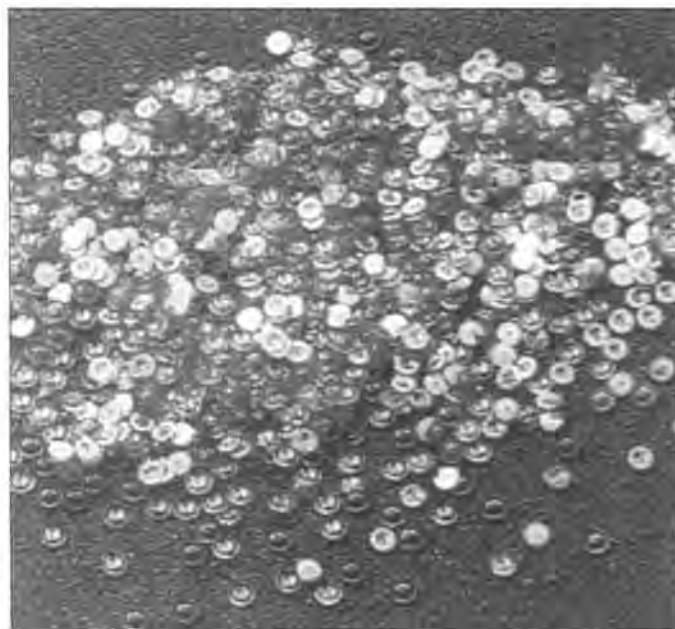




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How Many Jewels Would You Like?

Watch jewels have always raised the value of a watch in the minds of the consumer—no matter if the jewels have been functional or decorative. In the 1960s the issue got out of hand when the number of jewels became a way of marketing: “The more jewels, the better the watch.” Some watches had 40 jewels and only seven were functional!

In 1965 it became illegal in Switzerland to use non-functional jewels. At the time the number of functional jewels was also limited. The United States has always been a big market for Swiss watches; it was the U.S. customs who put a stop to the import of “over-jeweled” watches. The questionable marketing remained tightly controlled and stopped over the next ten years.

Today there is a special controlling body which determines the amount of functional jewels in any new watch movement. If the watch/movement manufacturer disagrees, it must show the functionality of the jewels. Manually wound watches generally have 14 to 19 jewels. Many automatic or multifunctional watches have about 20 to 30 jewels. If you, the reader, are a professional watch repairer, you have probably noticed that none of the high-end manufacturers ever printed the amount of jewels on the dial or the case. In other words, the quality of a watch and the quantity of jewels may not have much in common.

Tissot tried plastic jewels in the mid-1960s, but quickly shelved the idea. However, the idea lived on in inexpensive quartz watches. In them the jewels have been replaced with holes drilled directly in plastic plates. For example in some Rolexes the center seconds wheel is supported by a plastic bushing. In some applications ceramic jewels have replaced corundum jewels. Obtained by sintering, ceramic jewels have a polycrystalline structure while synthetic rubies have a single crystal jewel.

At the cheapest, a modern jewel costs only pennies, which means that taking a jewel from a customer's watch and fitting it into another watch does not pay at all financially. But surely the myth must be kept alive: I have a bag full of synthetic jewels from my customers' watches. How many would you like...?

Bibliography

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Comadur S.A. Brochure

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Robert D. Porter,
CMW

Repivoting for the Watch and Clockmaker

Part 2

Making a Carbide Spade Drill

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Figures 9, 10, and 11 picture an easy to make attachment for the watchmakers lathe that will allow us to reduce the end of the carbide drill blank to the size we want to drill the hole for a new third wheel pivot. The upper end of the steel post in the tip-over-tee rest has a 60 degree vee to support the drill. The post is tapped to receive a 3/16" diameter brass rod about five inches long. The "tailstock" part of the attachment slides freely on the brass rod and has a center to support the end of the pin vise so the vise can be



Figure 11



Figure 9



Figure 10



Figure 12



Figure 13

rotated by hand to reduce that part of the drill in contact with the diamond charged cast iron Waller™ lap to the diameter and back taper we need. The tailstock is locked in place with a 1/4-20 nylon thumb screw. The assembly is held upright with a rubber band. The lathe components should be protected from grinding grit with clear plastic cling-type food wrap, for example.

Figure 11 shows how the drill blank is supported in the vee to grind the drill to the .26 mm (.0102") diameter we need. The finished diameter is pictured in Figure 12.

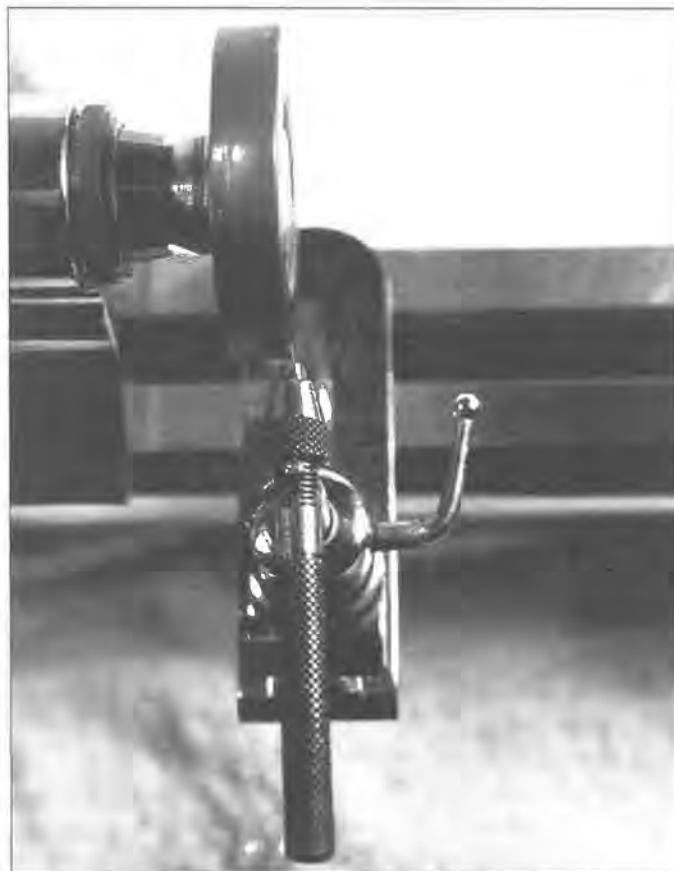


Figure 14

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The pin vise in Figure 9 has been modified with a pair of holes through it near the front of the vise. There is another hole that is drilled top to bottom exactly 90 degrees from the one we can see in this view.

After we have the drill bit ground to the diameter we need, we make use of another simple setup to finish the drill. Figure 13 illustrates how the front hole of the pin vise is mounted on an upright post that fits in the tee rest, to a height that puts the drill blank on the horizontal centerline of the lap. Figure 14 pictures the side of the drill blank being ground flat on one side, and then turned over on the post to grind the other flat side—like a screwdriver blade.

Figures 15 and 16 show how the tee rest base is skewed at about a 30 degree angle in relation to the front of the headstock, and then tipped back to allow the post to extend through the rest where it is then locked in place. This arrangement allows grinding the correct cutting and relief angles on the point of the drill. The lap is rotated backwards (clockwise) to grind the cutting edges and relief angles on the drill. The end is ground to the center of the drill, and then the pin vise is turned over on the post to grind the other cutting edge; it is very important that the cutting edges are exactly the same length. Figure 17 pictures a larger drill to better show the finished profile.

We will complete the pivoting of the third wheel in Part 3. ☺



Figure 16



Figure 17



Figure 15

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A Letter from the AWI-ELM Charitable Trust

Dear Member:

The AWI Educational Library and Museum Charitable Trust was organized to aid in the advancement of the art and science of horology through activities in education. Its purposes are:

- To lend practical assistance to the schools that engage in the teaching of horology.
- To establish and maintain a horological library.
- To establish and maintain a horological museum.
- To encourage and assist students in their horological studies.

The Henry B. Fried Library has grown to be one of the finest horological libraries in the world. We have recently expanded new shelving space by 50% to make room for the many new books that have been added in the past couple of years.

The Orville R. Hagans Museum has also grown and continues to grow through the generosity of AWI members and friends. All donations placed in the museum will include the name of the donor listed with the exhibit.

The Trust sometimes receives watch and clock movements and tools from manufacturers. These are distributed to schools of horology, that are members of the AWI Research and Education Council, for classroom use.

The ELM Charitable Trust realizes the future of horology in America depends on the continued supply of trained technicians. The Trust provides financial assistance to qualified students attending recognized schools of horology. Grants are also awarded to qualified AWI

members attending special watch and clock courses at AWI's Continuing Education offered at the Marvin E. Whitney Training Center. The amount of grant funds available depends on the number of requests and the amount of money received from the sale of spent silver oxide watch batteries and cash donations received from AWI members and friends.

The ELM Charitable Trust does not receive any monetary support from AWI. In order to carry out our mission, we must generate the funds to continue our work. We have always depended on the generosity of AWI members and friends. All gifts received goes to the work of the Trust. Fortunately, we have been blessed through the years to have Trustees who give of their time, talent and work with no recompense other than the satisfaction of doing something worthwhile so that others may benefit from their endeavors.

In order to provide the necessary funds to support our broad program of services, the Trustees have established an endowment fund whose principle will be protected and only the generated interest will be used to carry out the work of the trust. Through the generous contribution of a friend of the Trust, the foundation has been laid. In the past, we've depended on you to fund much of what we do. Now, once again, we need your support. Your contribution will help us to expand our resources and do a much more extensive job of preserving the past and building the future for our schools and students.

We ask that you contribute, not until it hurts—only until it feels good! All donations will receive a letter for tax purposes as all donations are tax deductible. Make your donation to the AWI-ELM Charitable Trust.

Your contribution really will make a difference.



Balance Staff Repivoting

James Sadilek

This procedure is very workable, but perhaps not economically practical. Surely it is within the capability of most whom possess the necessary equipment, but it is the type of work that interrupts the normal flow. I believe these jobs are best left to those who specialize in parts fabrication. Having said that, for those who still find themselves seized with the uncontrollable urge to repair the irreparable, consider this method as an alternative to turning a complete new staff.

Pivoting balance staffs by this method is suitable for large pocket watches and platform escapement balances. It works particularly well if the top pivot is broken, which it seems is usually the case. If the portion of the staff to be drilled has a diameter of less than 0.7 mm (sometimes the lower portion of even a large staff is too small) it may not be practical.

The key to the success of this operation is to use what dealers in industrial supplies describe as a combination drill and countersink. See Figure 1. To us old tool-makers it is a "center" drill. This type of drill is very rigid because it has a relatively large diameter body and a comparatively short, small diameter, drill length. The particular drill needed for this job is the smallest commonly available of the type, a #5/0 (size 00000)—the people who designated these sizes must have worked with 19th century watch manufacturers. The full description is No. 5/0 HSS (High-Speed Steel) 60-Degree Combination Drill and Countersink, Double Ended. The drill has a body diameter of 0.125" (0.317 mm), a drill diameter of 0.010" (0.254 mm) and a drill length of 0.010" (0.254 mm). Any firm selling metal machining tooling should be able to supply this drill. One large mail order industrial supplier, MSC (www.mscdirect.com) has them listed at \$4.72 each. If the cost seems high, it is somewhat offset by the fact that the drill is double ended.

The only tooling required for this operation not normally found with a watchmaker's lathe are the recommended drills. As in any machining process, even on this very small scale, rigidity is most important; this is a point that cannot be over emphasized. The lathe I use is equipped with a cross slide modified to hold the drill. The cross slide is a very rigid platform, and it provides an excellent means of feeding the drill to the work. Attempting this operation

by holding the drill in a worn tailstock quill will likely result in disaster. If there is any question regarding the rigidity of the setup, the prudent worker will ensure success by drilling a few practice holes to verify the setup before beginning the actual work.

To begin, let us assume that you have a large pocket watch of some obscure make that has a broken upper balance pivot. See Figure 2. Let us also assume that you have exhausted all reasonable probability of obtaining a replacement staff.

First, strip the balance assembly of the hairspring and roller. Measure the overall length of the staff, estimating the length of the broken original pivot. Record this measurement as well as the diameter of the unbroken lower pivot. The finished diameter of the new upper pivot should be the same as the existing lower pivot diameter unless someone has been here before us. It would be best to check this by placing the lower pivot into the upper hole jewel. If it fits, you're in business. If it doesn't fit, then you will need to determine the correct pivot size to fit the upper hole jewel.

It is probably easier and safer, before placing the balance assembly in the lathe, to stone away most of the conical portion of the broken pivot. Also the upper end of

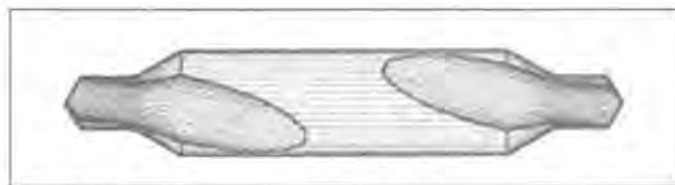


Figure 1

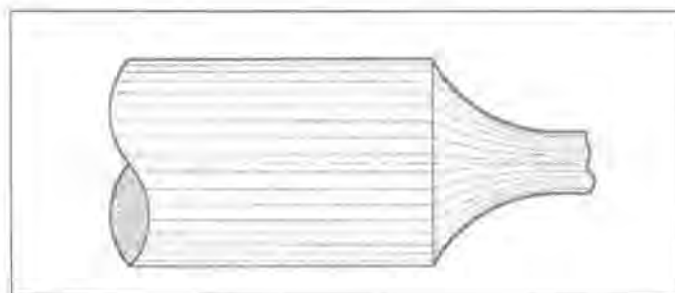


Figure 2

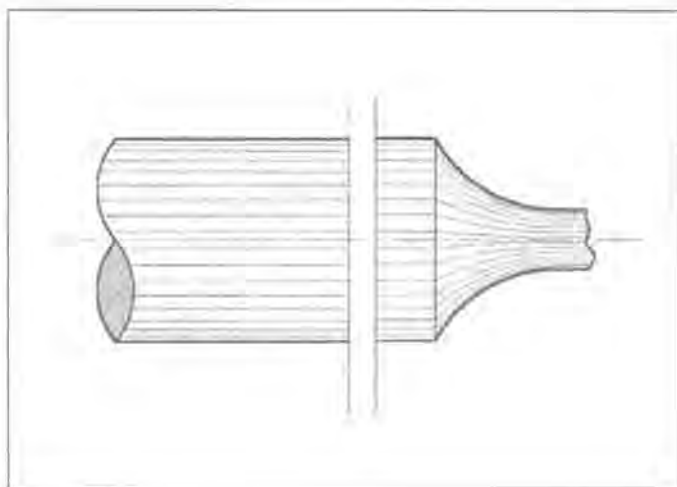


Figure 3

the balance staff needs to be annealed so that it may be drilled. Quickly heating the end of the staff to a blue color will provide sufficient annealing for drilling with a high-speed steel drill. A small electric soldering iron placed on the end of the staff will do the job, or lacking a soldering iron, a small piece of steel bar heated in the alcohol lamp will serve the same purpose. The key to this step is to heat the staff so quickly that only the top portion is annealed.

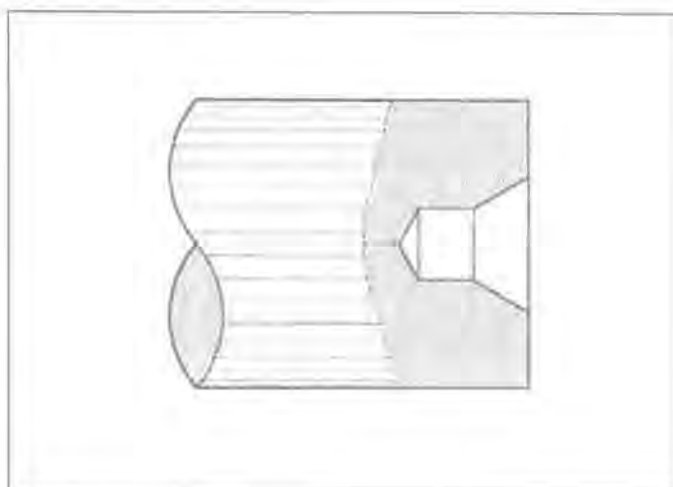


Figure 4

Stop heating before the color gets to the balance wheel. Holding the end of the staff in the flame of the lamp will not work—the heat is not sufficiently concentrated—the balance wheel will likely turn blue at the same time as the end of the staff. Of course you already knew all of this, but just in case...

Select the proper collet to hold the staff on the roller diameter. Yes, that portion of the staff is slightly tapered,

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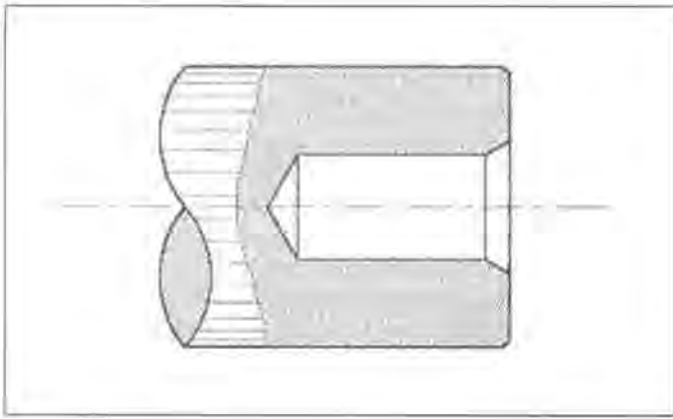


Figure 5

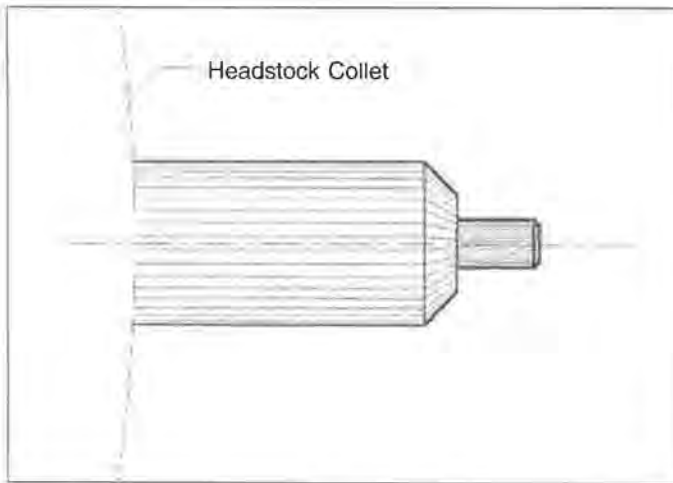


Figure 6

but it will hold; the stress put on the staff during the drilling process is mostly axial. Obviously the staff should be running true in the collet before any metal removal it started. In the interest of saving space and paper, it will be assumed, throughout the remainder of this article, that you, the reader, possess sufficient knowledge of the basic processes so as not to need pages and pages of cautionary advice. There is no need to kill trees reprinting information that already exists in the many available watchmaking texts.

With the lathe turning slowly, stone the end of the staff flat, removing the material a bit beyond the conical portion of the original pivot. See Figure 3. The objective of this method of pivoting, as you already know if you looked at the pictures before reading the text, is for the joint between the original staff and the new pivot to appear as an oil groove. Oil grooves are a normal feature on many high-grade pocket watch staffs. Properly hiding the joint is dependent on getting the end of the staff reasonably flat.

Because the center drill itself is quite rigid, it will when it is properly set up in the lathe tailstock or cross slide, drill a centered hole into the end of the balance staff.

This is the purpose for which these drills were designed. There is no need to resort to starting a center with a pointed graver. Drill the staff slightly beyond the full depth of the straight portion of the drill. See Figure 4. This hole and slight countersink will simplify the next step.

Now, using a fluted micro-drill, or pivot drill, with a slightly larger diameter than the center drill (0.30 mm - 0.38 mm) drill into the previously center drilled hole approximately two drill diameters (0.60 mm - 0.80 mm). See Figure 5. The pivot drill will automatically center on the previously center drilled hole.

If, at this point in the process, the hole in the staff matches the illustration (Figure 5), there should be a small 60-degree land around the drilled hole. The lathe tailstock center will fit nicely into this land. Supporting the staff's outer end with the tailstock center, polish away the blue color and slightly chamfer the staff outer edge as in Figure 5. That's it, take the balance assembly out of the lathe, the most difficult part of the job is done!

Using a piece of blue tempered steel pivot wire, turn the pivot plug as shown in Figure 6. The portion of the plug fitting into the drilled hole need not be a press fit. Turn it straight with a slip fit—about .01 mm clearance. The fit of the plug will be easy to check by using the drilled staff as a gauge. In turning the pivot portion of the plug (Figure 7) the dimensions are determined according to the measurements recorded prior to stoning the end of the staff. At this stage, the pivot portion of the plug is left slightly oversized. It can be finished, polished and the pivot end rounded after it is assembled to the staff.

Once the plug is turned, add a small groove at the junction of the pivot and the wire stock. Rather than parting the plug from the stock while it is in the lathe, you may choose to remove the pivot plug from the lathe while still attached to the wire stock. If the plug is parted from the stock at this point (Figure 8), it becomes a very tiny, difficult to handle and easy to lose part. Leaving it attached to the wire stock will make it easier to handle. Also, if you get clumsy, the cleverly placed groove will ensure that the part breaks from the staff at the proper point, and assuming you find the broken off part, you can still recover. There is a downside, explained in the paragraph on assembly, to leaving the plug attached to the stock.

The reason for making the pivot plug a slip fit is because it will be secured into the end of the staff with Loctite anaerobic adhesive. Anaerobic means the adhesive sets in the absence of air. This product has been in use by various manufacturing industries for many years and is widely accepted as a means of bonding parts. At the seminars it presents, the Loctite Corporation shows videotape of a helicopter whose maker assembles several critical components with Loctite adhesives. One assumes that since the chopper doesn't fall from the air, then watch parts similarly assembled will likely not come apart. Loctite

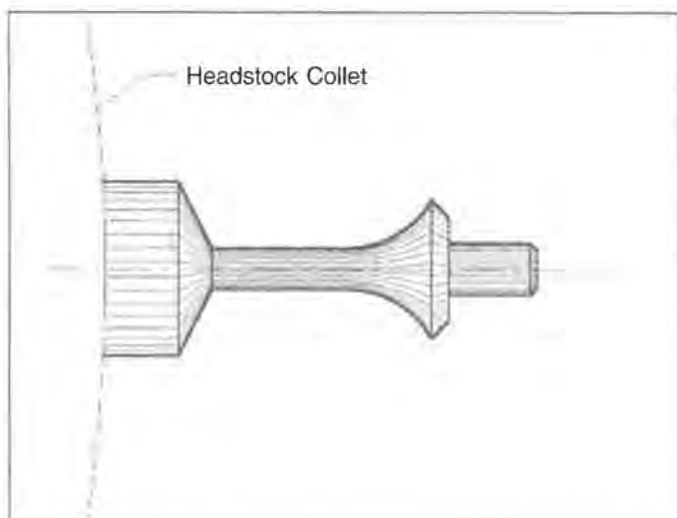


Figure 7

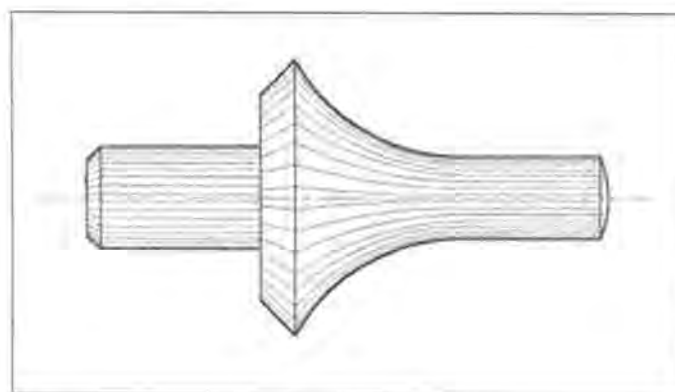


Figure 8

adhesives come in a number of varieties. A suitable type for this task that is readily available in small quantities (5 ml.) is the red threadlocker, No. 271. Most auto parts stores stock it. The blue threadlocker, No. 242, which is good for attaching watch crowns to stems, may not be strong enough to hold in this pivot plug application. The best type would be the green No. 680; in strength it is next to welding without the heat. To my knowledge No. 680 is

only available in 8 oz. bottles at about \$60 per bottle. That amount would be sufficient to supply every watchmaker in the world into the next century.

The actual assembly and subsequent adhesive setting is best accomplished with the staff in an upright position. This will ensure maximum concentricity between the staff and the pivot plug by allowing the viscosity of the adhesive to help center the plug in the hole. However, if



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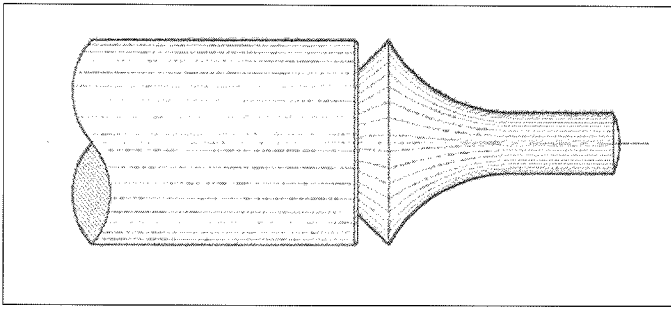


Figure 9

the decision was made to leave the plug attached to the original wire stock at this point, the added weight of the wire stock may cause the plug to lean sideways while the adhesive is hardening. With a close fit between the hole and the plug, the likelihood of misalignment is slight. The decision to separate the part or not is your decision. Place the balance assembly in a suitably sized hole in the bench block, drilled hole up. Coat the cylindrical surface of the pivot plug with a small (really tiny) amount of Loctite. If any Loctite is on the end of the plug, wipe it clean before assembly. Do not put Loctite into the drilled hole. The reason for this is to eliminate the possibility of breaking the

staff from the hydraulic pressure created by pushing the pivot plug into the hole. If Loctite is trapped under the end of the plug, pressing could create sufficient pressure to blow out the side of the hole. With this cautionary note in mind, push the plug into the hole and put the assembly aside for the adhesive to set up. Two hours is usually sufficient, but if you aren't pressed for time, waiting until the next day is best. After the assembly has set up, any adhesive outside the joint can be wiped away. The excess adhesive will not have hardened since it has remained exposed to air; this is one of the advantages of using anaerobic adhesives.

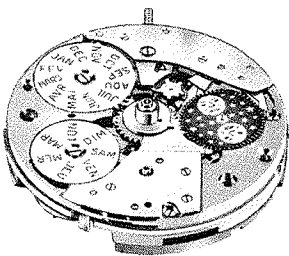
If you didn't part the plug from the wire stock previously, now by using your Exacto knife with an old blade—the one with the edge full of small nicks—saw the pivot away from the wire stock at the grooved junction. Finish the pivot in the lathe, or Jacot tool if you have one. Reassemble the watch, and make out the bill. Be sure to charge enough to cover all the perishable tooling and materials plus a couple day's wages and overhead.

Please feel free to modify or improve the process. I am available to answers questions and defend opinions. Please contact me through *Horological Times* e-mail: magazine@awi-net.org or snail mail in care of the *HT*.



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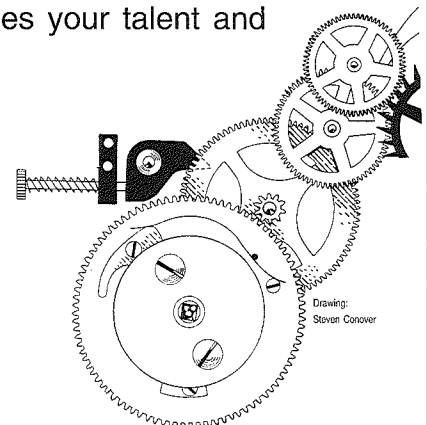
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Steven Conover

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AWI Movement Bank/Material Search Network

EDITOR'S NOTE: This column is designed to work in conjunction with the AWI Movement Bank. If you can supply any of the items listed here, please send details to the Material Search Network. **Do not send the items to AWI.** Members requesting these items will be advised of their availability, and will contact you directly.

- 101 Continental 13L, Series 261 Swartzchild winding pinion (#410/?), crown wheel (#420/?), or partial movement with barrel bridge.
- 102 Chelsea Clock #207966 pallet fork.
- 104 Rolex, ref. 4500 caliber 13 ligne ratchet wheel.
- 105 Longines 14.17 pallet bridge (#125), balance complete (#721), screw (#106023 [5105]), screw (#160600 [5425]), screw (#105015 [5430]), screw (#105018 [51142]), and case.
- 106 Addison Duplex Model K movement complete or motion works.
- 108 Longines 507 barrel complete, #182/?
- 109 Girard Perregaux 7709639 movement complete.

If you can supply any of these items please contact: AWI Material Search Network, American Watchmakers-Clockmakers Institute, 701 Enterprise Drive, Harrison, OH 45030-1696. Toll-Free: 1-866-367-2924; Phone: (513) 367-9800, Fax: (513) 367-1414 or E-mail: mhuff@awi-net.org.

The AWI-ELM Trust, in cooperation with the American Watchmakers-Clockmakers Institute, maintains a unique member service to assist professionals in replacing hard-to-find parts for vintage timepieces. When a member cannot locate a replacement part through normal sources, the Movement Bank/Material Search Network (which consists of movements, timepieces and materials donated to the Trust) is often able to help. There is a fee of \$10.00 for each search. The fee will be waived if a part or movement of equivalent value is donated to the Movement Bank.

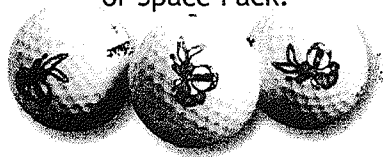
The AWI Material Search Network first contacts several dozen material houses and outlets on behalf of the member to determine if the missing part is available from any commercial source in the United States or Canada. If no other source is available, the Movement Bank is searched for a usable spare part. If found, the fair market value of the part will be assessed and the part made available for sale to the member. If the part cannot be found in the Movement Bank, the search will be listed in the *Horological Times*. ☺

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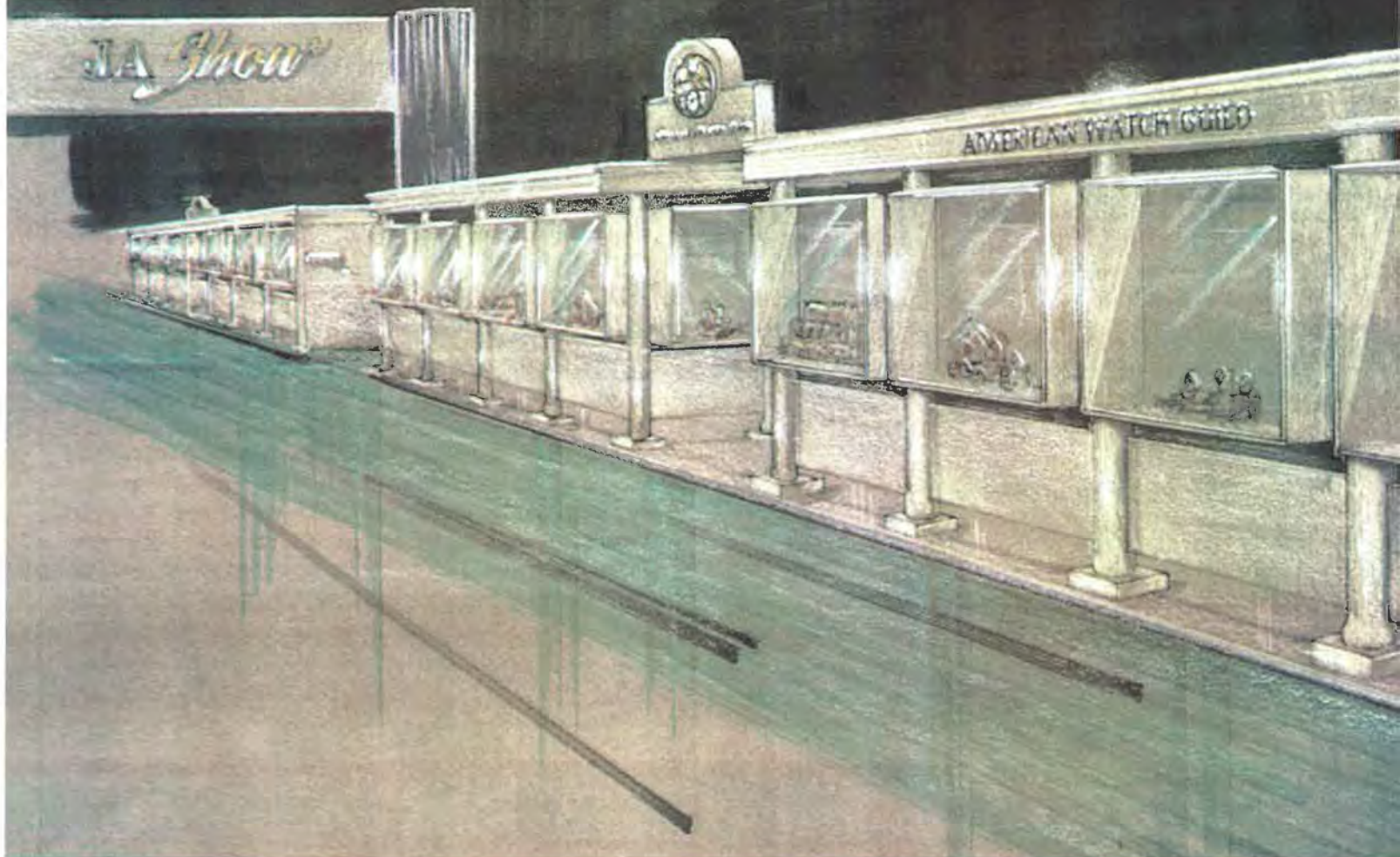
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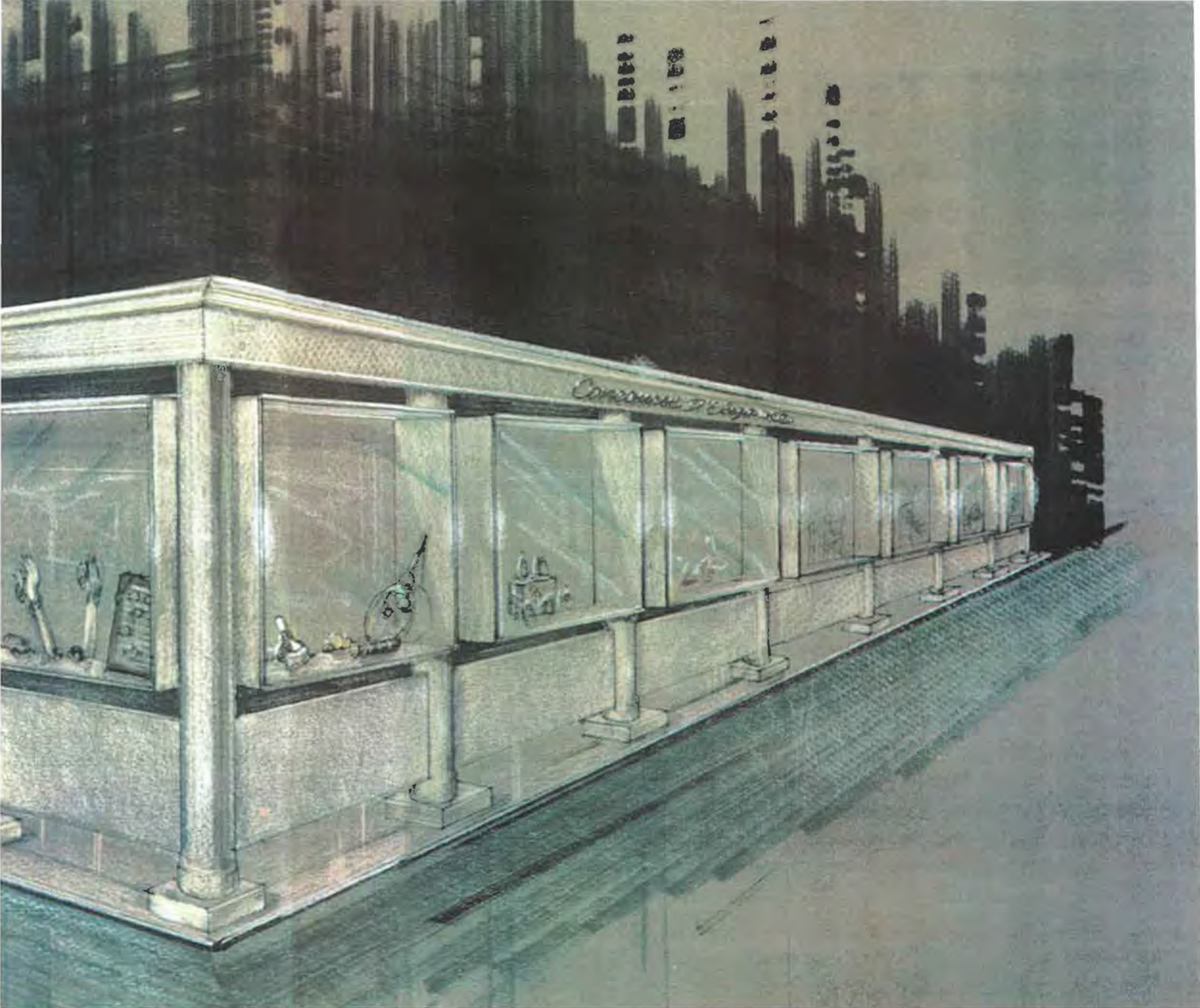
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Archie B. Perkins,
CMW, FAWI,
FNAWCC, FBHI

Technically Watches

Pocket Watches and Their Maintenance Part 36

Cleaning the English Fusee Lever Watch

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After the movement has been disassembled and all repairs have been completed, the parts are cleaned prior to being reassembled. The oiling is done during the reassembly process. Pocket watches can be cleaned by machine or by hand. I almost always clean pocket watches by hand in a water base, ammonia type foaming cleaner. This allows the plates and parts to be scrubbed with a brush to remove the old oil and residue that is so difficult to remove without brushing the parts.

Water Based Cleaning Solution

A water based cleaning solution can be made by the watchmaker by using the following formula:

Oleic acid (CP grade special light)	2 oz.
Acetone	4 oz.
Ammonia (Ammonium hydroxide 28%)	8 oz.
Distilled water to make	1 gal.

The ammonia and acetone vapors are very hazardous and should not be inhaled or gotten on the skin or in the eyes. This solution should be mixed in a well-ventilated place. Rubber gloves should be worn while mixing or using this solution. Adequate eye and face protection should also be worn. Always read and abide by the warning on the labels of these and other chemicals.



Figure 1

Mixing the Water Based Cleaning Solution

To mix the solution, take a clean gallon jug and pour the oleic acid and acetone into it. Now, take another clean gallon jug and fill it two-thirds full with distilled water. Pour the ammonia into the jug of water. Next, pour the mixture of ammonia and water into the jug containing the oleic acid and acetone. Then add distilled water to make a full gallon of solution. These chemicals can be purchased at a chemical supply house.

To avoid having to mix these chemicals, a solution similar to this can be bought from your watch material distributor in a concentrated mixture to which water is added to make one gallon of solution.

Another cleaning solution that can be used if the other two are not available is Parson's sudsy ammonia all purpose cleaner (regular clear type). This can be used full strength or diluted with water if desired. This cleaner does a satisfactory job on pocket watches. *Caution: Do not leave brass watch parts in an ammonia type solution for more than two or three minutes. The ammonia can remove material from the surface of the parts if left in too long.*

Rinsing Solution for Water Based Cleaners

Usually hot water is used as a first rinse for the

watch parts after they have been cleaned in the water based ammonia cleaner. This is best for removing any cleaning solution.

The final rinse should be isopropyl alcohol (99%). Ninety-nine percent isopropyl alcohol contains 1% water. Isopropyl rubbing alcohol can be substituted for the 99% isopropyl alcohol, except the rubbing alcohol has 30% water and, in this case, one must be sure to dry the watch parts long enough in hot air to evaporate all of the moisture on the parts. The same holds true for 70% ethyl rubbing alcohol solution. The best alcohol rinse would be pure grain alcohol (Ethanol). This alcohol is very expensive due to its heavy taxation.

Containers for Cleaning and Rinsing Solutions

Large mouth pint jars are a good size for cleaning and rinsing solutions for pocket watches. These jars should have screw tops. Figure 1 shows three of these jars. Shown on top of the jars are two brushes that can be used for brushing the watch parts with the cleaning solution. The smaller brush in the background is an old toothbrush. The brush in the foreground is a washout brush that is obtainable from watch and clock supply houses. Either brush will do a good job in cleaning watches, watch cases, and jewelry.

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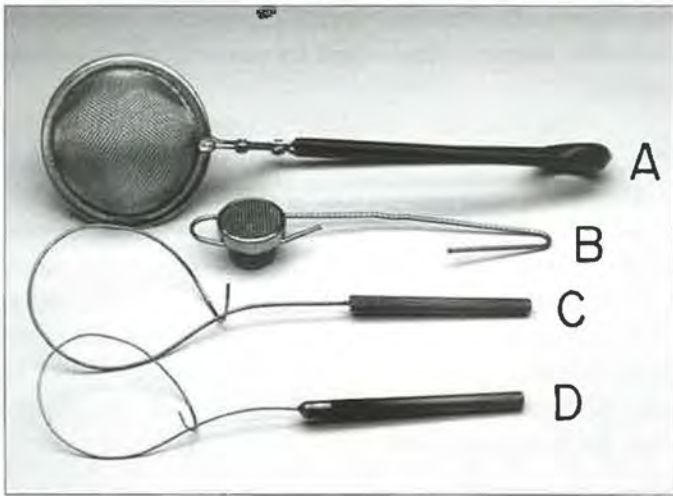


Figure 2



Figure 3

HOLDERS for Watch Parts While Cleaning the Parts

Figure 2 shows methods that can be used to hold watch parts for cleaning. View A shows a small parts basket that is used for small parts which do not have holes that allow the parts to be strung on a wire loop. This basket is made of stainless steel and it is opened by squeezing the handle that is attached to both sides of the basket. The

handle has a spring action which keeps the basket closed when there is no pressure against the two sides of the handle. Watch and clock supply houses stock this item.

View B, Figure 2 shows another small parts basket that can be used for the smaller parts of the watch such as jewel settings, jewel screws, and escape wheels. These baskets can also be obtained from your supplier. The

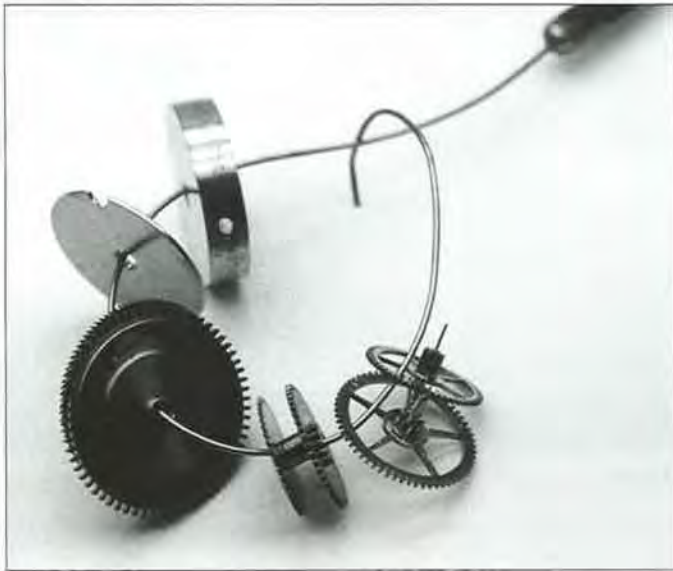


Figure 4

basket is made of stainless steel and has a screw top. The holder for the basket is made from a medium size paper clip.

View C, Figure 2 shows a large wire twirler used for holding the plates and bridges while they are being cleaned.

View D, Figure 2 shows a small twirler that is used



Figure 5

to hold smaller parts that have holes large enough to go over the wire of the twirler. These twirlers can be made by the watchmaker.

Stringing the Watch Parts on the Twirlers

Figure 3 shows the watch plates after they have been placed on the twirler. The plates should be placed on

B A L



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Figure 6

the twirler in a manner that prevents them from going flat against each other. That is, projections on the plates or bridges should prevent two flat surfaces from going against each other. When two flat surfaces go together, the tension of the solution on the two flat surfaces will hold the surfaces together which will prevent the surfaces from being well cleaned and rinsed.

Figure 4 shows the smaller parts after they have been placed on the small twirler. These parts should also be placed on the twirler so there will be some space between the parts. This allows the solution to reach all surfaces of the parts assuring that they will be properly cleaned, rinsed, and dried.

Figure 5 shows the watch parts after they have been prepared for the cleaning process. The parts with holes have been placed on the twirlers, and the other parts that will not fit on the twirlers have been placed in the cleaning baskets. *Note: The balance wheel and its hairspring should be cleaned separately in a basket or they can be placed on a twirler for cleaning if the balance wheel has a solid rim.*



Figure 7



Figure 8

Cleaning the Watch Parts

Figure 6 shows how the twirlers are rotated in the solutions when the parts are being cleaned and rinsed. The handle of the twirler is rotated between the thumb and fingers as shown. The parts should not be left in the ammonia cleaner for more than two or three minutes. After twirling the parts in the cleaner, they should be brushed to further clean the parts. After the brushing of the parts, they should again be twirled in the cleaner prior to rinsing the parts in hot water.

Figure 7 shows the parts being brushed with an old toothbrush and the ammonia cleaning solution. All surfaces on each part should be thoroughly brushed with the cleaner one piece at a time. **CAUTION:** Make sure that there are no loose parts on the different pieces being cleaned that could get lost in the cleaning process.



Figure 9



Figure 10

Figure 8 shows the watch plates being rinsed with hot tap water under the faucet of a sink after they have been cleaned in the ammonia solution. If a faucet and sink are not available, the hot water can be placed in a jar for rinsing the parts.

After the parts have been rinsed in the hot water, they are rinsed in the alcohol solution. The alcohol solution removes the water from the parts. The parts are again rotated or twirled in the alcohol rinse as they were in the ammonia cleaner. If it is desired, one can have two alcohol rinses. It is recommended to blot off as much water from the parts as possible before starting the alcohol rinse. This helps to keep down the water content of the alcohol. By using a second alcohol rinse, the last rinse will contain less water.

After the parts have been put through the alcohol rinse, the parts are dried with hot air. A hair dryer is excellent for this purpose. The small parts in the baskets are twirled in the solutions in the same order and dried with hot air. No brushing is needed on these parts.

After the parts have been cleaned, rinsed, and dried, they are placed in a clean tray to prepare for re-assembly. Such a tray is shown in Figure 9. This tray happens to be a sturdy plastic tray that a TV dinner came in. Its surfaces are shiny and easy to clean. The tray of parts should be covered to prevent them from being contaminated with dust and lint. Figure 10 shows a cover for the tray. This cover is a plastic cake cover that came on a cake from the supermarket.

Note: For information on the machine cleaning of watches, see the January, 2000 issue of Horological Times, "Technically Watches" column, pp. 20-25.

"Pocket Watches and Their Maintenance" will continue.



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If you enjoyed the 40th Anniversary, you'll love this year's encore of some of the more popular events. Attendance numbers were up considerably last year from previous years and we hope to continue the trend. Plan to attend and include the entire family to participate in the Northern Kentucky area entertainment. AWI will be having an Open House and Cookout with Clock Rodeo and Auction as well as a Reception and Dinner. Within a short distance of the hotel, family entertainment includes: the Cincinnati Zoo; Newport Aquarium; canoeing; health spa and even Riverboat Gambling for the more adventurous. Be sure to complete the registration form enclosed with this month's issue of *Horological Times* and return it to AWI before July 2, 2001.

Thursday, August 2, 2001

9:00 a.m. – Noon	REC Annual Meeting Chronometer Club Program AWI Classrooms - Harrison, Ohio
Noon – 1:30 p.m.	Lunch on your own
1:30 p.m. – 5:00 p.m.	Continuation of REC and Chronometer Club Program
3:00 p.m. – 6:00 p.m.	Registration - Hilton Greater Cincinnati Airport
7:30 p.m. – 10:00 p.m.	Round Table Reception

Friday, August 3, 2001

8:00 a.m. – 9:00 a.m.	Registration - Hilton Greater Cincinnati Airport
9:00 a.m. – Noon	Affiliate Chapter Meeting Keynote Speaker Peter Laetsch, Federation of the Swiss Watch Industry
Noon – 1:30 p.m.	Lunch on your own

1:30 p.m. – 3:30 p.m.	Affiliate Chapter Meeting (resume if necessary) Theme Chapters: Chronometer Club, Chapter 102
1:30 p.m. – 3:30 p.m.	ELM Trust Meeting (Trustees only)
3:30 p.m. – 4:30 p.m.	James M. Dodson Perpetuation Fund Meeting (Trustees only)
6:15 p.m.	Bus leaves for AWI Open House and Cookout
7:00 p.m. – 9:30 p.m.	AWI Open House and Cookout sponsored by the ELM Trust AWI-ELM Trust Battery Weigh In Clock Rodeo or Book Signing or Auction
9:30 p.m.	Bus leaves for Hilton

Saturday, August 4, 2001

8:00 a.m. – 9:00 a.m.	Registration
9:00 a.m. – Noon	AWI Board of Directors' Meeting
8:00 a.m. – 5:00 p.m.	Technical Presentations Clocks <i>Clock Escapements</i> Laurie Penman <i>Clock Restoration Practices</i> Jerry Faier, CMC <i>Organize Your Work Habits for Success</i> Bob Ockenden, CMC Watches <i>Diagnosing Poor Motion</i> August Cornell <i>Isochronism & Positional Adjustments</i> Dr. Matthew Clark <i>What's Hot—What's Not, Rolex Fakes</i> Charlie Cleves
11:00 a.m. – 3:00 p.m.	Trade Fair
11:30 – 1:30 p.m.	Luncheon Buffet
1:30 p.m. – 4:30 p.m.	AWI Board of Directors' Meeting resumes
6:00 p.m. – 7:00 p.m.	President's Reception
7:00 p.m. – 10:00 p.m.	Dinner Buffet & Awards Program

Sunday, August 5, 2001

8:00 a.m. – 9:00 a.m.	Grand Café Breakfast Buffet
9:00 a.m. – Noon	AWI Board of Directors' Meeting



Mark Butterworth,
CMC

The Modern German Clock Movement

Part 13 Falling Weights

Sometimes articles simply come by inspiration, and this one has been inspired by the many questions on the subject since last writing. To summarize them, the question is "Why don't the weights fall evenly in my grandfather clock?" or "Why don't they fall at the same rate as the old movement?" One's sense of proportion tells us that at the end of the week, when all the weights started at the top of the case, they should all end up even at the bottom. For that matter, it seems reasonable that they should also descend evenly and be at the same height in the middle of the week also.

In some cases, when the weights are uneven or descending at a different rate, the movement is indeed malfunctioning. But there are many situations in which this is perfectly normal for the movement. I think it makes sense to first describe those situations in which a new replacement movement may act differently than the old one or when the existing movement seems to act differently:

1. If the customer decides to shut the chimes off at night (usually for guests), the chime and strike weight do not descend because the chime train is locked. This is also true if the autonight shutoff is used. Most of the new clocks have this autonight off feature and if the chime and strike are not operating for 8 hours, that is one third of the time and the weight will fall one third less. The exception: in the Kieninger H, K, and R series if the chimes are manually shut off, the chime drum is moved to a position where it turns but does not lift any pins. As a result, the strike does work and the weights still fall evenly. If the strike is also shut off in the Kieninger, a lever pulls back the strike hammers so they do not engage the rods and the

striking continues but the hammers do not strike the rods. If the autonight off feature in the Kieninger is activated, however, that weight does not descend evenly but by a third less as in the other German movements.

2. If one is trying to be precise, the strike weight will not fall evenly with the chime and time weights if the measurements are not taken at the same time of day over a period of several days or a week. This is true to a lesser extent with the chime weight. We know that the time weight falls evenly and continuously. This is not true with the other two weights. As an example, if one winds the clock at 1:00 P.M. on Monday and decides to check the weights at 7:00 A.M. on Saturday, the strike weight will not have fallen as far as the other two. The reason is that the strike is a building cycle over a period of twelve hours. At 1 o'clock the weight falls far enough to strike only once while at 12 o'clock it must fall far enough to strike 12 times. From 8 o'clock to 12 o'clock the strike must occur 50 times ($8+9+10+11+12$) during those 4 hours. From 1 o'clock to 7 o'clock, the strike occurs only 28 times even though it is $7/12^{\text{th}}$ of the total time. We received a call this week about a very particular person who stated that the rate of fall differed by $1/4$! In fact, it is possible for the difference to be more than that. To a lesser extent this is also true with the chime weight although its cycle is much shorter—one hour. The first quarter needs enough drop to play only 4 notes on the Westminster, while it needs 16 notes on the hour. Of course, all this assumes that one wound the weights to the same weight to begin with as exactly as possible, which is not always the case. Keep

in mind also that it is not possible to wind the weights exactly together by more than one half click of the winding wheel. In addition, if the unit has stopworks, chances are that the weights will not wind exactly to the same height due to the stopping position. Alas, life is not perfect.

3. Sometimes internal changes are made in the movements which cause a difference in fall of the weights occurring between the new and the old unit. The new Hermle cable wound BS and BSK series will have a drop which is greater because the internal gearing was changed to deliver greater force or torque to the gear train. In order to accomplish this, a greater amount of fall per day of the weights will take place. This is rarely a problem, but occasionally a short clock case may develop a problem in which the weights hit the floor before a complete 7 days. The solution is to wind the clock twice a week; we suggest Wednesday and Sunday. Kieninger made a limited number of two-week movements in the K series, which is the common able drive triple chime ones. Unfortunately these were not marked, but the chime weight is VERY heavy-about 16 pounds. As a result the weights will drop twice as fast with a new movement than the old. Of course it is also true that the weights will not fall evenly if either the chime or strike is not functioning properly. What are the possibilities?

1. The chime and strike weights fall together, but a lesser distance than the time weight. This is due to the chime not working on each quarter. Since the strike is activated by the chime, when the chime is not functioning, neither will the strike. This problem can be either intermittent or systematic. If systematic, the most likely culprit is the 4th quarter in which the chime correction does not allow a complete unlocking of the chime train. The exception: the Urgos uw03 series will allow the strike to release each hour whether the chime works or not.
2. The chime and strike weights fall together, but a greater distance than the time weight. This occurs when the chime fails to stop at one or more of the quarters, sometimes intermittently.
3. The strike weight falls a greater distance than the chime weight. It can be normal as discussed for the Kieninger unit, but most likely it is the result of the strike not always locking when it should and producing an extra strike. It can also occur if the rack hook falls behind the snail. This results usually in a strike of 12 o'clock. It is not common,

but it is possible that faulty rack teeth or a bent gathering pallet pin is also the problem. A worn bushing for the gathering pallet is a common cause as it changes the distance between the gathering pallet pin and the rack teeth.

4. The strike weight falls a lesser distance than the chime weight. This is a result of the strike either intermittently not working or not doing a full strike when it does. The most common problem is to strike 1 o'clock at both 12 and 1. The solution is to set the strike for 12 when setting up the strike sequence.

I hope that these ideas will help you solve some of your "weighty" problems.

Final thought: *"Life is like riding a bicycle. You don't fall off unless you stop pedaling."*—Claude Pepper (Senator and advocate for seniors)



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J.M. Huckabee,
CMC, FAWI, FBHI

As a Clockmaker Turns

Staking Tools and Techniques

Part 1

Objective

Many readers over many years have inquired about staking tools and staking techniques for the clockmaker. The questions are: What tools are needed? Where are they available? How are they used? This two-part series will show some of my tools and some of the uses. This will give some idea on a narrow facet of clockwork. Each clock size needs different tools. The watchmaker's staking set works pretty well on small clocks. I won two sets of those. One is in excellent condition that I use with discretion. The other is used for "rough work." Being my choice is mid-size clocks, those tools, have very little use. My most active punches are mostly shop built.

In these two articles, I will show some typical techniques, along with some uses that are often considered controversial.

A Classic Riveting Job

It is rare indeed that a rivet can be picked from an assortment that exactly fits the need at hand. For that reason, I lathe-turn the rivets that are needed. Let's turn a rivet and fit it into a movement.

One of "Old Huck's" full-blown lathes is shown in Figure 1. That has "too much baggage" to make a rivet. The lathe (same one) in Figure 2 is all that is needed to make essentially any rivet in a clock.

Figure 3 shows about 5 minutes of work to make a large rivet for a winding click. Do not cut the rivet free from its parent raw material. Study Figure 4. The tang has a cup a little deeper than the expected upset end.

Assemble the Pieces and Finish the Job

Use the parent stock as a handle to

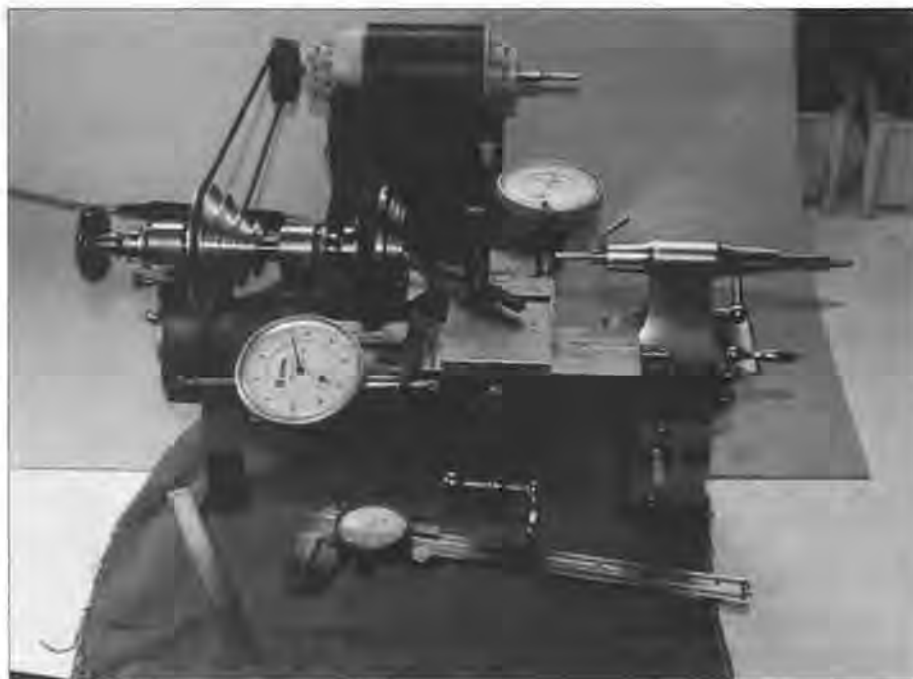


Figure 1. A full-blown watchmakers lathe. This one was built around 1915 by Boley. It has been "Huck's workhorse" for over half a century.



Figure 2. The lathe of Figure 1 as used in this article. The work on this job was no more than 5 minutes of run time.



Figure 4. What you cannot see is a deep conical cup of about 60 degrees angle in the end.

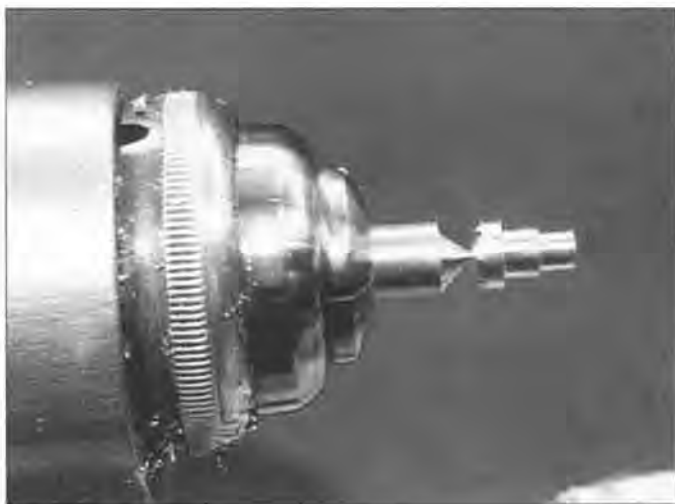


Figure 3. Here is what can be done in 5 minutes: A perfect fitting rivet quicker than you search one out of an assortment of pieces.



Figure 5. Use the raw material stock as a handle to assemble the pieces. Hold pressure downward and break away the handle.

assemble the pieces. Press down and break away the handle as shown in Figure 5. Now study the bur left on the rivet head in Figure 6.

The riveting process is backed up with a heavy smooth bench block. Figure 7 shows how the head looks after the job is completed.

The rivet tang is upset in two distinct steps. First it has the tang expanded by a ball, or a conical punch. Second, it is crushed by a flat-faced punch. I used a conical punch followed by the flat face on this job. Study the caption of Figure 8 for the exact detail.

The punches used are shown and described by Figure 9. These are 4 inches long and 1/4 inch diameter—shop built.

Although I own a vast number of punches and staking tools, those described under Figure 10 do most of my work. Punches not shown are the hollow ones. They are

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Figure 6. Breaking away the handle leaves a small bur on the rivet head. This head will be supported by a heavy bench block.

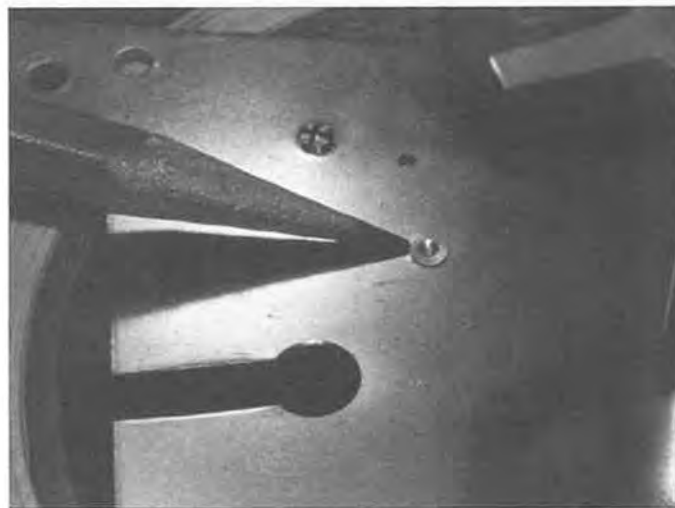


Figure 8. A single hammer stroke to a punch with a 120 degree tip spreads the rivet end. A single stroke on a punch with a flat face completed the job.

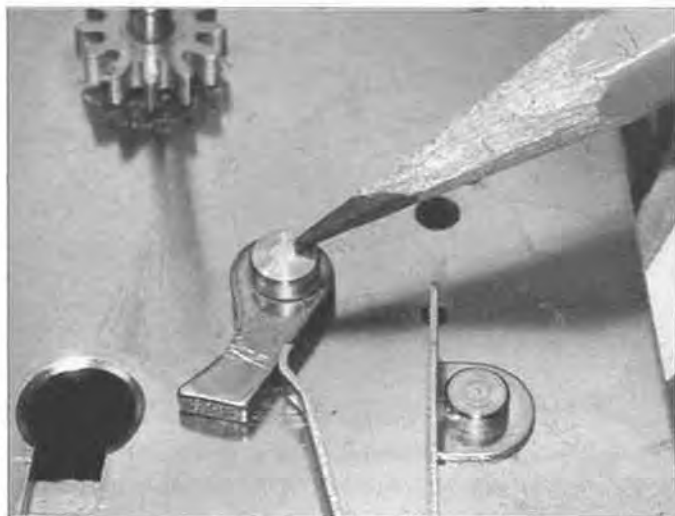


Figure 7. After the riveting process, the bench block surface was replicated on the rivet head, and the bur is gone.



Figure 9. A bronze conical punch and a steel flat-faced punch did the job with a single stroke each.

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Figure 10. Clock staking punches: Most are over a half-century old. All are shop built of bronze and steel. Small pieces are broaches, pivot gauges, oilers, etc. All are active working tools.



Figure 12. The large rivet is the job at hand. The small one is original to this AWI student practice movement.



Figure 11. Lathe tools used in this article. Modified hobby knife ground as a cut off tool. Wood handles $\frac{1}{2}$ inch diameter, 4 inches long. Tool bits are $\frac{3}{32}$ inch square spring steel stock about $1\frac{1}{4}$ inch long.

mostly 3 inch lengths of hollow brass tubing from the hobby store. Wood dowels are also used as may be seen in many of my articles.

What lathe tools are used to make that rivet? I use the most simple form of hand-held lathe gravers. They are all shop built and held as you hold a large pencil, with handles approximately parallel to the bench top. See Figure 11 for the tools I used on this rivet. I have 15-20 of these tools, ground in various shapes. I grind them with a soft-backed grinding wheel in a hand-held motor tool.

Study Figure 12 and compare the job to the smaller original rivet in the same illustration.

Conclusion

Most poor staking workmanship is the result of trying to achieve a result with improperly sized pieces. In reality, good staking practices achieve excellence with great ease.

The second part of this series will show a number of techniques for working brass, mostly dealing with movement plates. ☺





Jack Kurdzionak, CW

From the Workshop

You Are Invited

Do you have a solution to a watch or clock repair problem that you want to share with our membership? Do you have a question about a repair problem you would like to ask? I invite you to participate in this column with your suggestions, questions, and comments. It's easy. Just e-mail me at AWI <magazine@awi-net.org> or write using the old standby known as the postal service. You can even fax me at 513-367-1414. I will do my best to help you help the membership. By sharing your questions and suggestions all of our members can benefit from our combined knowledge and experience.

Invest in a CD

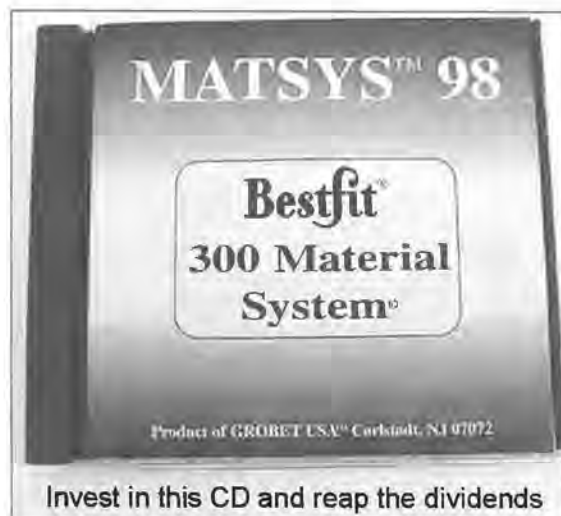
There is a CD available that every watchmaker should own. It's not one that you buy at the local bank nor is it one that you get at the Tower Record Store. This one you get from your favorite material supplier. It does not play any

music nor does it yield a fixed rate of interest. It does pay dividends to its owner and it will pay them for as long as it's used.

This CD is called the *Bestfit 300 Material System*. It is one of the best tools a watchmaker can purchase. Of course it requires a modern computer equipped with a CD-ROM and a person willing to spend less than an hour learning how to use it. You might say, "Why should I buy the CD? The material dealer has one and he can look up the parts I need. That's what he gets paid for." Yes, he has a CD in his computer and yes, he does get paid to look up the parts for you. I don't think it takes too much imagination to realize that anytime you help someone do his job it won't be forgotten.

For example, you need a set bridge for an A. Schild caliber 2063 and you call your favorite material dealer and request the part. He will look it up and ship you the part. If you have the Bestfit CD you can look up the set bridge. You will find that it is part #445/1223 and order it by part number. You also will find that same part fits sixteen other A. Schild calibers besides the one you are repairing. You might have one of those sixteen other calibers available as a parts movement. If you do, you have already bought the part and it's in your stock available for immediate installation. If you don't have it, you can accurately call in the part by caliber number and part number thus helping your supplier get the part to you quickly and correctly the first time. The material dealer always appreciates this help and you get the added dividend of getting the right part the first time it is shipped.

The supply of spare parts for out of production and obsolete movements is shrinking every year. Our used movement collection will become more useful and valuable as every



year passes if we put it to good use. It's a waste of your time to guess which movement parts will interchange with another movement and which will not. Taking used movements apart in the hope that a part might match just because the caliber is similar to one being repaired saves neither money nor time and it usually wastes both. Even if the part does fit the movement being repaired, it might not function, because it is the wrong part. Eliminate the guesswork. Get a copy of the Bestfit CD, install it into your computer, and use it every time you need a spare part. Just to reinforce this time and money saving tip, I checked the interchange of the ratchet wheel for the same A. Schild caliber. Forty different A. Schild movements share that same ratchet wheel #415/1123. Help yourself by using the best information you have available for your business.

Jack Kurdzionak

A Tacky Idea

The task of painting a pair of watch hands can be a messy operation. If you just put the hands on a flat surface and paint them, you get paint on everything around the hands in addition to the hands themselves. It's messy to pick up those hands and move them while the paint dries. If they aren't moved, the paint will dry and the hands will be stuck to the flat surface. Instead of that method, try mounting the hands on a weighted upright pin such as a balance tack. Put the hour hand on first then the minute hand. Paint them both with your favorite brush and allow them to dry while remaining upon the pin. When they are dry they can be safely removed without damage to the painted surface.

Jack Kurdzionak



Balance Tack used to support watch hands while they are painted

It's in the Bag

These two suggestions come from our Research and Education Council director, Frank Poye. He finds it all too easy to scratch a watch case or crystal during crystal installation utilizing a crystal press equipped with metal dies. To prevent this damage he suggests putting the watch case and crystal in a plastic bag and then using the crystal press to press the crystal into the case while the watch case is in the bag. The clear plastic allows you to view the work while it prevents any surface damage to the crystal or the case. The same technique is also appropriate for pushing crystals out of a case. Remove the case back and movement from the watch case then put the bezel into a plastic bag. The crystal can now be safely pushed out of the bezel. If the glass shatters as it is removed, all of the shards of glass will be contained in the bag. None will get into the base of the crystal press or all over the workbench.



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The 75th Minnesota Watch and Clockmakers Association Convention

Doug Thompson, CW, CEWT
President, MWCA

The 75th Minnesota Watch and Clockmakers Association Convention was held on March 3-4, at the Holiday Inn Minneapolis West. This annual gathering was a success for everyone in attendance. It was great to see fellow horologists from neighboring states (Iowa & Wisconsin), as well those from Minnesota.

Saturday started off with the **ETA 7750 Chronograph Course**, with St. Paul Technical College instructor, Joe Juare. Students were taken through this popular, complicated caliber step by step with the help of a close focus camera and TV monitor. Common mistakes made by repairmen working on this movement and techniques to help repair it efficiently, were the focus of this bench course.



Hands-on help with Joe Juare.



Jerry Faier lectures at the Basic Skills course.

Down the hall from the ETA class, AWT's Jerry Faier was guiding students through **Basic Clock Repair Skills**. Assisting Jerry throughout the session were MWCA members, Bob Ockenden, Ray Flood, Richard Zielike and Jerry's wife, Susan. This course was customized for us by Mr. Faier and those attending had plenty to do. Starting with horological metals, students experimented with brass, tool and cold rolled steels, including annealing and case hardening techniques. Next, burnishers were made by all, with materials provided and everyone was able to practice polishing pivots with them in their lathes. Proper depthing between wheels and pinions was discussed, as well as correcting misaligned pivots with reaming and broaching. Main-spring handling, servicing, when to replace them and the math involved in determining their replacement was the final topic.

The excellent Saturday evening buffet was attended by several former MWCA past presidents. Our keynote speaker, Bob Porter, brought everyone up-to-date on current AWI activities and he then took questions (with a few tough ones) from the audience. At the end of the dinner proceedings, MWCA honored Albert Lea, MN watchmaker Chuck Sandager with its, **Horologist of the Year** award.

The **Horological Auction** followed dinner with auctioneer, Bob "Shecky" Ockenden taking the bidders through a variety of items that included: a water resistance wet tester, ultrasonic cleaners, lathes, and more than a few



Basic Skills participants polish pivots while those in the back anneal steel.



Doug Thompson and Ken Kuhn preparing burnishers Saturday morning.

horological mysteries that intrigued everybody. During the auction our hospitality people kept everyone satisfied with homemade bars, cookies and soft drinks at the back of the ballroom.

Sunday morning started out with **MWCA Annual Business Meeting**. Members were updated on the financial as well as horological activities of the organization,



MWCA President Doug Thompson speaks at the evening dinner.

including our member e-mail group, which will use the very successful AWI Chronometer Club model as a guide. We said good-bye to Dale Offerman who retired from the board after 6 years of service and said hello to Greg Booth who was elected to the vacated board position. In the next several weeks a member survey will go out asking a variety of questions. This survey will help us plan for member needs and the future needs of the association.

The Sunday morning seminar, **Lathe Skills**, given by Bob Porter was very informative. Bob customized this presentation for us and made it relevant to both

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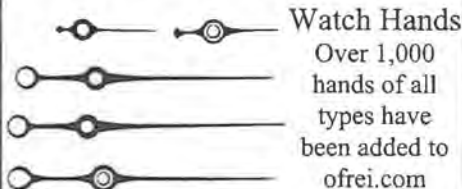
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clockmakers and watchmakers. Repivoting techniques, using methods that have served him well, special tools that he has made (including a carbide graver with a finish that would rival any mirror), along with a great handout, kept everyone interested. He also disassembled a lathe, explaining the processes he uses to clean and maintain his own lathe. Seeing just how simple it is to service a lathe should make everyone feel just a bit guilty if they don't do it regularly (me included).

The afternoon seminar, **Horology, Computers and the Internet**, could have been a disaster when the



Chuck Sandager receives MWCA Horologist of the Year award.



Bob Porter at the Saturday Buffet.



Past MWCA Presidents (L to R): Dick Rasmussen, Bob Nelson, Ray Flood, Maurice Grundei, Steve Naber, Mark Cormier, Janet Larson, Rudolph Benson.

original presenter was unable to attend. Thanks to members Joe Juare, Dick Redman (an IBM employee for several years), and the kind people at VISICOM (who gave us a free dial up account for the weekend), we were able to demonstrate e-mail procedures, how and where to surf for horological links, appropriate security measures and how the future MWCA e-mail group will benefit our members. Kudos to Mr. Redman for the handout he supplied with information beginners as well as experienced users found valuable.

The final Sunday seminar, **Electric Clocks**, was presented by Jerry Faier. There's a market out there for the repair of these common, but often beautifully cased clocks. Focusing primarily on the GE, Revere and Telechron units, the audience was shown how to deal with the rotors and motors in them. Rotors cut in half for demonstration purposes were handed out for inspection and attendees were shown techniques in drilling out rotors for lubricant replacement. Experiments and bench tests that he has conducted over the years were discussed and questions were taken on a variety of electric clocks.

Good conventions don't just happen, a lot of people work hard to bring about the success of those conventions. Thanks to: Ray Flood for his work on the convention booklet; Janet Larson who organized the wonderful hospitality we received and for the photographs she took; Mike Judes for the door prizes; Cindy Matiski, Dale Offerman, and Kathy Sehr for a number of duties they performed; Jeff Pomeroy for photographs he took; Jerry Faier, Bob Porter, Joe Juare, Bob Ockenden and Dick Redman for their great presentations; Joe Arbiter (Seiko), Black Forest Imports, Chelsea Clock Co. Inc., Clockmakers Newsletter, Dayton's Jewelry Repair Center, Empire Clock, Esslinger & Co., Newall Manufacturing, Swatch Group, Thomas Joseph & Sons Inc., Twin City Supply, and Vibrograf USA



Bob Porter at Sunday's *Lathe Skills* seminar.



Dick Redman and Joe Juair speaking at the *Horology, Computers, and the Internet* seminar.



Jerry Faier talking about *Electric Clocks*.

Corp. for their sponsorship and finally to Richard Zielike who worked with the hotel staff planning the convention and for the work he did with Jerry Faier to customize the Basic Skills course. Great job every one! See you all next year.



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☐ Hairspring Vibrating	TBA	☐ Servicing ETA Quartz Chronographs	Tamara Houk
☐ Introduction to American Pocket Watches	Alice Carpenter	☐ Servicing the Seiko 5C23B Quartz Chrono/Alarm	TBA
☐ Introduction to Clock Repair	TBA	☐ Striking Clocks	TBA
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JUNE 2001				
9-10	Recoil Escapement - Solid & Strip Pallet	Laurie Penman	Atlanta, GA	\$200.00
SEPTEMBER 2001				
15-16	Recoil Escapement - Solid & Strip Pallet	Laurie Penman	Detroit, MI	\$200.00
OCTOBER 2001				
6-7	Recoil Escapement - Solid & Strip Pallet	Laurie Penman	Chicago, IL	\$200.00
20-21	Recoil Escapement - Solid & Strip Pallet	Laurie Penman	St. Louis, MO	\$200.00

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MAY 2001			
7-11	Introduction to Clock Repair, Phase IX General Clock Part Making	Laurie Penman	\$250.00
14-18	Introduction to Clock Repair, Phase X Grande Sonnerie Carriage Clocks	Laurie Penman	\$250.00
JUNE 2001			
6-9	Servicing a Tower Clock	Lloyd Larish	\$250.00
18-22	Disassembly of the Rieffler Clock (Includes tour of Cincinnati Observatory)	Laurie Penman	\$250.00
25-29	Assembly of the Rieffler Clock (Includes tour of Cincinnati Observatory)	Laurie Penman	\$250.00
AUGUST 2001			
6-10	Making Your Timepiece	Laurie Penman	\$250.00
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2001 Member Survey Results

The results of the member survey conducted in conjunction with the 2001 AWI membership dues renewal campaign are as follows: *(Please note: Not all members completed the member survey.)*

1. Check the following categories from which you derive your principal source of income:

Watch repair/servicing	419	Clock sales	138
Clock repair/servicing	294	Watch sales	113
Jewelry repair/servicing	12	Jewelry sales	56

2. Do you use a computer at:

Work	96	Both work and home	638
Home	463	Neither	349

3. If you use a computer, does it have Internet access?

Yes	1,221	No	2,574
-----	-------	----	-------

4. An electronic e-mail survey will be conducted in the near future by AWI to help us determine new services/products as they relate to our members' computer usage and the Internet. Would you be willing to participate in this survey?

Yes	927	No	2,768
-----	-----	----	-------

5. Would you like to receive timely AWI announcements via e-mail?

Yes	923	No	2,772
-----	-----	----	-------

6. Would you participate in on-line or computer-based bench courses?

Yes	802	No	2,893
-----	-----	----	-------

7. From 1 (low) to 5 (high), rank the effectiveness of the following AWI services by answering the question: *The most important values that I receive from my AWI membership are:*

Educational

	5	4	3	2	1
AWI Traveling Bench Courses	332	85	94	50	178
Project Extend Course	116	85	118	71	208
AWI Certification	212	79	119	55	188

Home Study Courses

	218	93	104	65	174
Affiliate Chapter Meetings	143	76	104	70	233
Support of vocational training for new watchmakers/clockmakers	211	93	103	64	173

Technical

	5	4	3	2	1
AWI Material Search	294	115	141	57	128
AWI Library	329	132	149	68	94
Technical Bulletins	520	132	105	35	101

Media

	5	4	3	2	1
Horological Times	855	90	44	11	77
AWI Website	117	101	124	92	155
AWI Website Weekly Chat Sessions	57	35	88	84	233
Purchasing AWI Publications	129	85	140	87	145
Purchase/rent AWI videos	168	96	139	82	131
AWI Merchandise	76	49	105	89	235
AWI Member Services	198	110	124	67	133

8. From 1 (low) to 5 (high), rank the value of the following *Horological Times* features:

	5	4	3	2	1
President's Message	206	134	233	127	150
Executive Director's Message	193	120	228	141	145
Questions & Answers	598	245	142	54	65

Ask Huck	524	216	136	70	79
Education Update	275	181	203	108	95
Rock Quarry	329	157	172	98	134
Letters to the Editor	273	214	226	94	79
Affiliate Chapter Report	119	92	191	162	203
Material Matters	363	201	197	111	82
AWI New Members	124	89	170	152	228
From the Workshop	490	238	170	57	60
Bulletin Board	245	174	215	115	70
Classified Advertising	295	212	212	117	96

9. The following are ideas for new features in *Horological Times*. On a scale of 1 (low) to 5 (high), rank the importance of these concepts to you.

Educational

<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>
Business Tax Tips				
249	132	131	109	201
Business Management				
236	122	163	98	192
Shop Management				
291	150	174	104	155

Time Management	244	131	169	108	167
Hazardous Waste and the EPA	219	130	172	109	173
Restoration of Clocks	636	128	74	84	119
Restoration of Watches	591	134	97	81	134

Technical

<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>
Manufacturers' Technical Bulletins on Clocks				
521	149	126	87	125
Manufacturers' Technical Bulletins on Watches				
566	126	117	83	132
Repair Articles on Clocks				
666	131	118	68	107
Repair Articles on Watches				
658	126	105	69	123

Other

<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>	
AWI Staff Profiles	93	92	214	176	213
AWI Board Member Profiles	118	98	202	166	202
Historical Articles on Clocks	462	192	186	71	112
Historical Articles on Watches	461	193	141	77	121

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NEW REQUESTS

At press time no new requests were received.

RESPONSES

OBAMA Injector Automatic Watch Oiler

Tom Mister, Dashto Jewelers, Inc., Virginia Beach, VA, responded to Norman Shafer's request for an owner's manual and/or instructions on an OBAMA Injector Automatic Watch Oiler. AWI would like to thank Tom Mister for the original copy for the AWI Technical Department.

Nutone Electric Chime Clock Instruction Booklet or Service Bulletin

Robert Miller, All Service, Inc., Billings, MT, was able to provide information for Richard Sneary's request for an instruction booklet or service bulletin on a Nutone Electric Chime Clock.

Car Clock

Robert Miller, All Service, Inc., Billings, MT, responded to Steven Pizzarella's search on how to repair and/or technical information on a car clock. Mr. Miller suggested writing to K.E.S. Engineering, 502 North Maple, Prospect Heights, IL 60070.

ITEMS STILL NEEDED

Preciso

Bobby Long, Euless, TX, is seeking information on the watch brand Preciso (Standard). The Preciso watch is a 15 jewel, licence auchere brevetes. S.G.D.G. #1098471.

Atmos Bellows Ethylene Chloride

Allan Lipney, San Rafael, CA, is seeking patent information on Atmos which might give some insight on the amount of Ethylene Chloride used in the Atmos bellows.

Ladder Chains

Mr. Daniel T. Moore, Kansas City, MO, is looking for 144" worth of strong (11 lb.) ladder chains that have 40 links per foot.

Hamilton-Sangamo Electric Clocks Service Bulletin

The AWI technical department is looking for a good, clean copy of the Hamilton-Sangamo Electric Clocks Service Bulletin, dated November 1929.

Do you have information regarding this month's requests? Do you need information about one of this month's responses? If so, send your information or requests to:

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St. Germain, Robert—Sebring, FL
Wheeler, Don M.—Miami, FL*

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Emig, Richard—Kalamazoo, MI*
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Ruch, David—West Plains, MO

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DuPree, Don—Reno, NV

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Tomacc, John—Cranford, NJ

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Schliesser, Paul—Cincinnati, OH

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Judy, Dean—Jacksonville, OR*

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McNutt, Ralph—Clarion, PA

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Bristow, Nick—Dallas, TX

Utah

Buhler, Stanley N.—Sandy, UT

Washington

Gregor, T. A.—Woodland, WA

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Stoltenberg, Randall L.—Mercer, WI*
Taylor, Kevin J.—De Soto, WI

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Pellerin, Karine—Becancour, Quebec

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Spurrell, John K.—APO, AE

* AWI welcomes back these individuals who have chosen to reinstate their membership.

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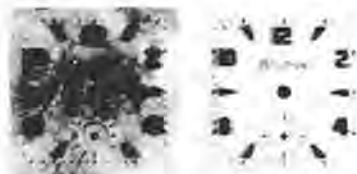
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Grab the best value in Hands and Crowns...while they last!



Stick Hands

These assortments contains 6 sizes hour hands, 8 sizes minute hands, and 4 sizes sweep second hands. 180 pieces total. 3 colors available.

900.608.G Yellow Hand Assortment

900.608.B Black Hand Assortment

900.608.S Silver Hand Assortment

CLOSEOUT **\$9⁹⁵ea**

Buy All Three Hand Assts - SAVE \$4.85

900.609 All Three Assts **\$25⁰⁰**



Waterproof Crowns

Assortment contains five each yellow and two each white crowns of nine sizes. Includes two Japanese style crowns. All tap 10. 63 pieces total. Made in Hong Kong.

900.603 Crown Assortment

CLOSEOUT **\$9⁹⁵**

Call Today.
Supplies are Limited.



Japanese Waterproof Crowns

Assortments contain five each yellow and two each white of nine sizes. 63 pieces total. Includes three Japanese style crowns. Available all tap 10, tap 11, or tap 12. Made in Japan.

CLOSEOUT

900.604 Tap 10 Crown Asst .. **\$19⁹⁵**

900.605 Tap 11 Crown Asst..... **\$21⁹⁵**

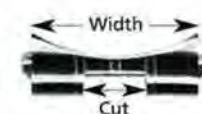
900.606 Tap 12 Crown Asst..... **\$21⁹⁵**

Buy All Three \$63.85 Value - SAVE \$10.90

900.607 All Three Assts **\$52⁹⁵**

Our end piece assortment saves you time and money on band repairs

POINTED TYPE		White	TuTone	Yellow
Width	Cut	PW-13-6	PT-13-6	PY-13-6
13mm	6mm	PW-14-6	PT-14-6	
14mm	6mm	PW-14-7		
14mm	7mm	PW-14-2C	PT-14-2C	
14mm	2Cuts	PW-18-7		
18mm	7mm			
18mm	8mm			PY-18-8
18mm	9mm	PW-18-9		
18mm	10mm	PW-18-10		
18mm	2Cuts	PW-18-2C	PT-18-2C	PY-18-2C
19mm	7mm	PW-19-7		
19mm	8mm		PT-19-8	PY-19-8
20mm	8mm	PW-20-8		PY-20-8
20mm	9mm	PW-20-9		
20mm	10mm	PW-20-10		
20mm	2Cuts	PW-20-2C	PT-20-2C	PY-20-2C
22mm	8mm	PW-22-8	PT-22-8	
ROUNDED TYPE		RW-14-5		
14mm	5mm	RW-18-8	RT-18-8	
18mm	8mm	RW-19-8	RT-19-8	
19mm	8mm		RT-20-8	
20mm	8mm			
STRAIGHT TYPE		SW-18-8	ST-18-8	
18mm	8mm	SW-20-8		
20mm	8mm			



Assortment contains two each end pieces (72 total) in sizes and colors shown at left. Includes pointed, rounded and straight styles.

900.629 Watchband End Piece Assortment..... **\$24⁹⁵**

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THEIR NAME

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ON THE INSIDE.



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