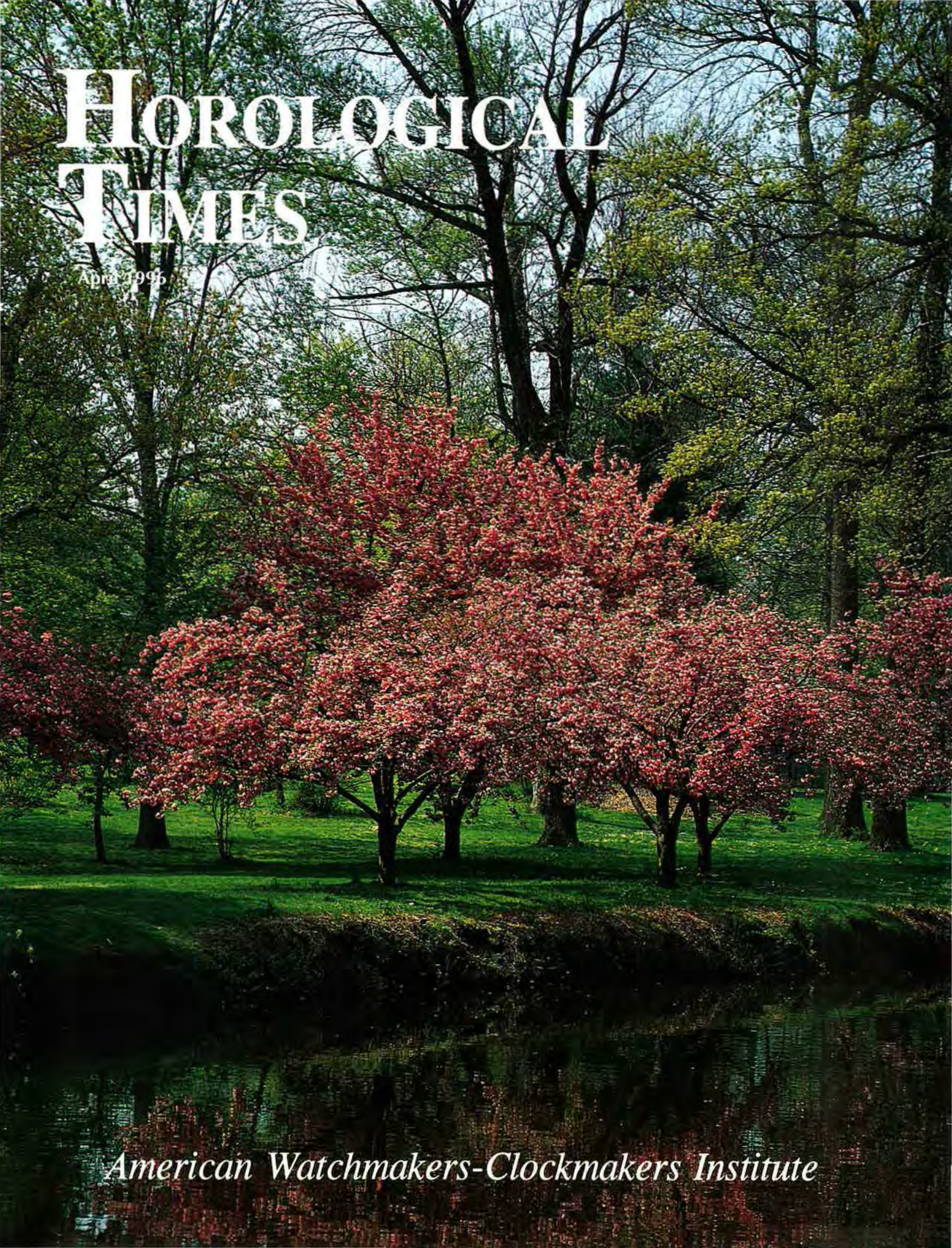




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HOROLOGICAL TIMES

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At press time we learned of the death of Henry B. Fried, March 10, 1996. Details will be in the May issue.

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THE AWI EDUCATION, LIBRARY, MUSEUM (ELM) CHARITABLE TRUST

James H. Broughton, Chairman

Purpose

The ELM 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 schools that engage in the teaching of horology
- To establish a horological library
- To establish a horological museum
- To encourage and assist students in their horological studies

The ELM Charitable Trust is administered by five Trustees. They are selected by the Executive Board and approved by the AWI Board of Directors. Two are appointed in the year's ending in odd numerals. Their term of office is for two years. The Trustees elect their chairman.

Student Loans

Assuring an adequate supply of qualified technicians is essential to the vitality of the horological profession. The Trust aids needy students by making student loans to those who are studying in an approved school of horology. The Trust also aids needy students by making grants to those attending Project Extend classes.

Most of the money used for making loans and grants comes from the sale of used silver oxide watch batteries donated by AWI Affiliate Chapters and members across the United States and its territories. Loans are available based on the needs and the amount of funds set aside for this purpose. Interested individuals can obtain details by contacting AWI Central.

Practice Materials

Because donations to the Trust are tax deductible, individuals and firms frequently donate watch and clock movements to the Trust. These are distributed to the schools of horology for use as practice movements in the classroom. At times, surplus spare parts and tools are also available.

Educational Programs

The Trust has recently expanded its activities to include educational programs. The first of these, the Key Test by Ewell Hartman, provides for small group training in diagnosing problems in quartz watches.

Movements, manuals, and a cassette tape are the media used for instruction. A small fee for shipping, insurance, and maintenance is charged each participant. As funds become available, the Trust will add to the number of programs it offers.

Henry B. Fried Library

The Henry B. Fried Library is considered to be one of the finest horological libraries in the world. The Trust recently doubled the library space at AWI Central and added many more hardbound volumes to its collection.

Many books are stocked in multiple copies. These, as well as others that can be easily replaced, can be borrowed from the library by members of AWI at no charge. The library also has expensive books, or books that would be difficult to replace for which a deposit is required. There are still others that are irreplaceable and are restricted to library use for research.

Continued on page 56

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QUESTIONS

& ANSWERS

By Henry B. Fried, CMW, CMC,
FAWI, FBHI, ★FNAWCC

QUESTION

I have inherited a particular pocket watch from my father. I am trying to find out all I can about its history, value, rarity, and time period of manufacture.

The only information I have about the watch is a letter my father received from the Record Watch Company of Geneva in March 1959. They advised him that they made the watch in the



1900-1903 time period and that only two or three pieces existed in the world.

I have been to the library but haven't been able to find any information concerning this piece. Enclosed are pictures I have taken for you. Could you please help me figure out all there is to know about this Sector Fan pocket watch.

*Mark H. Bruton,
Rocky Mount, North Carolina*

ANSWER

I have your correspondence regarding the Record Watch Company's Sector watch, made in Tramelon, Switzerland in the first fifteen years of this century. The watch was invented and patented by G. Sgherlino on May 30, 1903. However, I disagree with that company's declaration that only about three of these have survived. In my time I have repaired dozens of these, most often for other watchmakers who in their ignorance of the under-dial intricacies created the damage.

I have one in my own small collection of watches although I have owned more like it in my time. They are still offered for sale in auction catalogues and at meetings of watch and clock collectors. I have seen these with many different case decorations and decorations in high relief which include horsemen, religious depictions, period portraits of the female head and shoulders, etc.

Henry B. Fried

QUESTION

How was the decorative damascening done on the movements of turn of the century railroad-grade pocket watches? I am interested in reproducing this effect. As a toolmaker by trade, I would welcome the challenge of making such a machine to duplicate this process. Also, do you know what type of steel was used for the plates and bridges in these watches?

Robert Doris, Prescott, Arizona

ANSWER

The decorative designs you see on watch cases and on watch movements were put on by an engine-turning process of very involved lathes. These are termed Holtzapfel lathes and can be set up to engine-turn various repetitive geometric designs. A slight turn of one of the many adjustments will alter that design. Thus on watches, say of American make, it was possible for the special operator of such a lathe to do each movement and obtain a different effect.

One of our members, Mr. Ted Crom of Florida, has a sizable selection of such lathes and he prizes them highly. I was able to obtain a lesson on operating these some years back but I doubt whether I'd be able to duplicate what I did without his close guidance. These lathes could do spirals, scrolls, ellipses of all types, a figure eight, etc. One museum we visited in Villers l' Lac in France on the Swiss border had a whole selection of those devices and samples of the cases they produced.

Henry B. Fried

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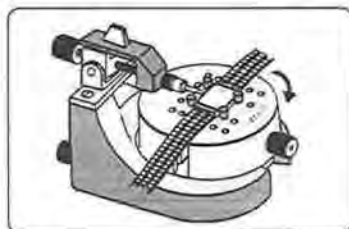


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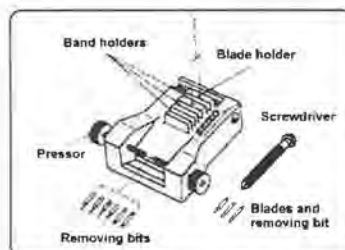
Tests the drive train of analog quartz watches. Frees up hands that are stuck. The Cyclonic supplies a pulse to the stepping motor to check a stopped train without having to open the case. The power of the pulse can be adjusted to be much stronger than normal, restarting hands stopped by a small particle or thickened oil. The speed of the pulse can also be adjusted to be much faster than normal, cleaning or clearing the train. Switch watches can be jump-started when otherwise they cannot be repaired. Also includes a built in battery tester. Made in Switzerland.

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Link Pin Remover



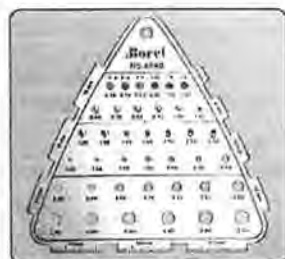
Essential for removing pins from metal link bands. Made of black Keltec 11 glass-filled nylon, this unit includes two extra spacers to accommodate all bracelet sizes. The pusher pin is hardened tool steel. Will not scratch or mar gold or silver. **HOL118.00 \$ 12.00**



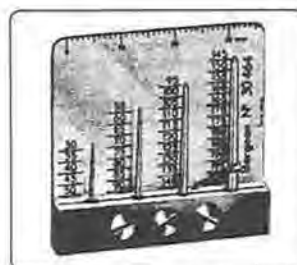
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ASK

HUCK

By J.M. Huckabee, CMC, FBHI

Hand Clearance Problems

Q. I have a clock with a hand-to-dial and hand-to-glass clearance problem. The hand touches the glass in one area, and touches the dial in another. It appears the center arbor is not upright in the movement. How can this be corrected?

A. This condition is often found, but to a lesser degree than you describe. I suspect you are overlooking another problem even though it appears the center shaft is not perfectly upright.

Let's explore some possible causes. Does the dial mount on the movement, or onto some case feature? A dial mounted to the case is more likely to have the trouble. Inspect movement-to-case mounting and dial-

to-case mounting. This may be a simple case problem that is readily correctable.

We must assume that the trouble did not exist when the clock was new. For those which have the dial attached to the movement, I would suspect a bent center shaft. This may be checked by watching the tip of the minute hand shaft as the movement spins down. For a movement that is in operating condition, a bent shaft will probably be on the outside of the plates, rather than between them.

Old American clock movements are sometimes "racked" from a broken mainspring. This is generally obvious, and pillars are easily straightened. They will usually function when somewhat racked, provided the pivots are quite loose.

I believe your problem to be something other than

upright error of the center arbor.

Cleaning and Lubrication

Q. A large portion of my work is antique, or "semi-antique" clocks. What do you think about use of modern cleaning solutions and lubricants for this type of work?

A. This is a frequent topic of discussion at meetings held by a group of clockmakers with whom I'm acquainted. I listen to their methods, cleaning solution debates, and merits of new miracle-working lubricants. In fact, lots of the stories sound like pure fiction.

The purpose of cleaning is to restore appearance and function. We lubricate to reduce friction and extend longevity to the movement. These are our prime objectives, with others of lesser importance. Another consideration is that we should render no damage to either appearance or performance.

Our economic success dictates that we do our work within the bounds of reasonable profit, at an affordable market price. This brings us face-to-face with working at the highest rate of productivity and the highest quality

results. We cannot permit quality and productivity to penalize each other. This criteria really sounds impossible. Now we are ready to judge our methods.

Yes, I'm very much for our modern cleaning solutions, drying equipment, assembly and test equipment, lubricants, and lubrication methods. These are the things that have given our trade its very life in inflated economic times.

Once we have reasonably achieved a well-equipped shop, the job has just begun. We must now improve the skill of our hands, educate our minds, and manage our time. We must build ourselves, as well as the facilities of our shop. Think what it will do to your business if you turn out an additional one or two jobs per day over what you were doing six months ago. ☛

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*All efforts have been made to ensure a smooth transition to our new
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AS A CLOCKMAKER TURNS

TOOLS AND TECHNIQUES FOR REPIVOTING GEARS

PART I

By J. M. Huckabee, CMC, FBHI

Objective

A broken pivot in clock gearing has long been a nightmare to every clockmaker. The objective in this two-part series is to show the tools and techniques that will solve this age-old problem in an efficient use of time, and also result in a very reliable repair. In fact, it is a repair that will frequently not even leave a trace of work evidence.

The technique uses prefinished spring steel wire for the new pivot. This material is hard, well finished, and a subsequent break is essentially unknown.

Most of the tools are simple in nature and may be shop-built, or similar substitutes may be purchased. Part I of this work deals with familiarization of the tools, and Part II with the actual repivoting job. The wheel is from a midsize American clock that is approximately fifty years old.

The Problem

This is the second wheel from the time train of our clock, chosen because its large size favors photographic views. Look over Figure 1. This was a deliberate break-off, so that we can see the piece. Our repair will drill the arbor on exact center, and press-fit a new piece into that arbor. The new piece will insert into the arbor about four to five diameters deep.

The new pivot must be of equal size, length, shape, and finish of the original. It will be made of spring steel, which is too hard to cut with typical hand-held gravers. Most of the work will be by grinding. Grinding is fast and easy, and prefinished material is a great time-saver.

Grinding Tools

The hand-held grinder uses two types of abrasives. Figure 2 shows a pair of Dremel stones on shop-built arbors. These may be used in the lathe, or in the motor tool of Figure 3. That is a small battery-operated tool. The stones are about 1" in diameter, and 0.032" thick. These stones are smaller from use. They are Dremel #400,

available from many sources.

The accessories in Figure 3 are abrasive paper and a soft-backed disc. Both are mounted on an arbor similar to those in Figure 2. The soft back is about ten plies of poster card and about 2 1/2" in diameter. I also use these in 1" diameter and four to five plies. Many abrasive types and grits may be used. The one shown here is a Norton product called Adalox, in a grit size of 220 (see Figure 3). Finer grits are very useful in this type of work. Most hardware stores handle the material.

The Steady Rest

A simple shop-built steady rest is shown in Figure 4 and other views. Other forms may be used with similar results. This one is not suitable for turning with tool bits, but is very handy for drilling and grinding. The support rods are brass, with a V-notch, and a hardwood dowel. The wooden support holds lubricant and may be run at zero clearance, even at high speed.

The major problem with a steady rest and repivoting an arbor is competition for work space. The piece must be held very close to the work area.

Cutting Tools

The cutoff tool of Figure 5 is ever in use. This one is ground from the blade of a hobby knife, and cuts brass and mild steel easily. The hand-held graver of Figure 6 is a square-shank tool ground to a diamond tip. It is forming a cup center that we will use to support our wheel.

The Steady Rest Setup

The setup of Figure 7 is suitable for working an arbor that has considerable length. The left support is a brass rod with a flat end and a V-notch. That rod is 1/8" in diameter. The right rod is a wooden dowel of the same size fitted with a 1/4" end-pad of similar material. A drop of oil makes this setup run nicely at all speeds. This support is fragile in every direction except on the axis of rotation toward the lathe spindle. Therefore, it is only suitable for the low-stress grinding

"The major problem with a steady rest and repivoting an arbor is competition for work space. The piece must be held very close to the work area."



Figure 1. A broken pivot is shown. The following tools solve that problem quickly.



Figure 2. Thin rotary stones are used to cut very hard, prefinished pivot material.



Figure 3. Modern abrasive paper on a soft-backed disc is driven in a battery-powered motor tool.



Figure 4. A steady rest is needed for repivoting work. It is not suitable for turning.



Figure 5. A cutoff tool is used in many types of lathe work. This one cuts mild steel and brass with ease.



Figure 6. A cup center is cut in a piece of brass rod. This will support and drive our repivoting work.



Figure 7. The steady rest setup is shown. This wooden dowel permits high-speed operation at zero clearance.



Figure 8. A smaller dowel is used if the arbor length is short.



Figure 9. This pivot must rest in the cup center, and the two pieces must be coupled together.



Figure 10. The coupling is a piece of paper masking tape.



Figure 11. Hold the arbor tight in the cup center, and pinch the tape in place.



Figure 12. Grinding the conical tip on an inserted pivot.

and drilling we will use.

Exchange ends with the arbor of Figure 7, and view the result in Figure 8. We begin to run out of wheel and arbor space. In this example the right support rod is a dowel similar in size to the brass rod.

How do we drive this wheel, and what holds the system together? Look over Figure 9. First note the proximity of the wheel and short arbor end, and the steady rest frame. This shows the type of space problem that may be encountered with a steady rest.

How do we drive the system, and why not hold the arbor in a collet? (See Figure 9.) We do not use a collet because of alignment problems and run-out in that type of setup. This cup center was cut in perfect truth, and supports that pivot with some forgiveness for alignment error. Not only is this simple, it is best for accuracy. Yet we must couple these pieces together in order to drive our arbor. (See Figure 10.)

The force of drilling and grinding is in the direction of the lathe collet.

Essentially, all we need is a coupling. A piece of paper masking tape about 1/2" wide, and 1" long is ideal. The pieces must be free of oil. Study Figures 10 and 11. Hold the arbor tight in the cup center and pinch the tape in place. I place the piece diagonally across the joint, pinch the sticky faces together, and start the motor. This secures the tape. Avoid long run times that are not productive. Drilling and grinding force keeps the pivot seated solid in the cup center.

To continue in Part II, I will drill a hole that is 0.059" in diameter to a depth approximately to the wheel hub of Figure 1. A single layer of tape is suitable for that operation. For bits somewhat larger, two plies can be used. Should your bit hang up, the paper joint will break apart, rather than break your drill bit, another advantage of this drive technique.

What We May Expect

Near the end of Part II, you will see an operation somewhat like Fig-

ure 12. The new pivot is in place, and the grinder is finishing the tip. First it is ground to length, then a conical tip of about a 120° included angle is formed. The wheel is driven at about 3,000 RPM and the grinding disc is run at top motor-tool speed. Only a couple of seconds of work to finish the pivot.

You may also expect the residue from the tape to present a problem. It must be carefully cleaned before the pieces are returned to service. I split the tape along the arbor with the tip of a hobby knife, hold the overhanging flap, and roll the lathe by hand. This "unwinding" will usually carry away all the tape residue. Other methods, such as petroleum solvents work well.

Forward

Part II will show the step-by-step process in replacement of our broken pivot. Now that we are familiar with the tools, that repivoting job can be achieved in about fifteen minutes—no longer a clockmaker's nightmare. ☺



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ROCK QUARRY

By Fred S. Burckhardt

A wise man once said, "Tools are an extension of your hands!" This is a very deep and thought-provoking statement, especially to those of us who find tools are necessary in order to complete our daily tasks. Where would you be if it weren't for all those tools lying on your bench and in your bench drawers.

The question is not whether it is necessary to have tools, but just how many are really needed? As an example, on my bench right now I probably have ten pairs of tweezers. Some, I never use. Others, I use quite often. How many pairs are really needed? I would say I could get by with maybe three pairs at the most. One pair for take-down and reassembly. Another for fine work like adjusting hairsprings, and the third would be an old pair for doing things that might damage the others.

There are also ten or twelve screwdrivers on top of the bench. Once again, how many are used during the average day? Three sizes are plenty: fine, small and medium. How often do you use the large bladed ones, except if you are working on a pocket watch or do a lot of prying. Now I know some of you are saying, "You should never use your screwdriver for prying." True, but how many of us do?

Oilers aren't too bad as they only make a few sizes, even though two are plenty. The same

goes for hand removers, how many sizes do you need? Blowers are also useful. I used to use the metal ones you get at the supply houses. You know the kind I mean, the ones that always break. I went to a drug store and bought a rubber something or other that's used to clean baby's ears. That was about twenty years ago and the thing is still good.

A drawer full of pliers is another thorn in the side. Some I obtained in years gone by that still to this day, I have no idea what they are used for. Once in a while I'll pick up a pair and stare at it for several minutes trying to come up with some idea as to why they were made, but rather than tax my brain I'll slip them back into the drawer.

What about the specialty items? For example, what do you use to close canon pinions? I have at least two tools besides my staking set that are for that purpose. What do I use? The only thing I ever used is a pair of nail clippers. I know some of you purists out there are gasping for air but after closing thousands of canon pinions, I still think my way is best. They are even great for closing hairspring collets and clipping stud pins or other small wire. I never use them for clipping my nails even though I'm sure they'll do a good job.

There is one tool that I'm really fascinated with even though

I don't know what it is or what it is used for in watchmaking. The fellow that sold it to me didn't know what it was but since it was at the supply house, it must be something that every watchmaker should have. One of these days I'll find out what it is and let you know.

Clock repair tools also seem to grow and reproduce. Once in a while I'll come across one that I forgot I even bought. At the time it was something I couldn't resist as I knew it would be a real time-saver. According to the flyer, it was a tool that every clockmaker needed if he/she was going to stay in the business. Now I'm afraid to get rid of it thinking that maybe I'll have to quit the business or something. Don't forget the bushing tools, mainspring tools, tools for taking things apart and tools for putting things together, tools for taking care of other tools, and tools for replacing tools that are now obsolete.

Sometimes I think back and wonder how we ever got along without the fancy ultrasonic cleaners and timing machines. Maybe we are scaring people away from our profession when we tell them about all the expensive equipment and tools they need to get started in this business.

Must go now as I just received a new tool catalog and I want to see if there is anything I can't live without.

PICKLE BARREL

JEWELRY REPAIR,
PART 17-B

FLUXING, SHIELDING,
ANNEALING, AND PICKLING

By Marshall F. Richmond, CMW

“Sulphuric acid is good for pickling nonferrous metals but it will actually dissolve ferrous metals.

When handling and immersing nonferrous metals in sulphuric acid, steel tweezers should not be used because they can be damaged by the acid.”

The last article covered fluxing and shielding, so this one will discuss annealing and pickling. Annealing is a very important part of making or repairing jewelry. Work-hardened metals require annealing. Most metals, including both ferrous and nonferrous metals, get work-hardened from hammering, bending, rolling, drawing, or even natural vibrations from wearing. Finger rings work-harden from just the everyday handling of metal objects such as eating utensils or from using metal tools. For this reason it is important to know how to render metal dead soft if bending or shaping is required. All metals we encounter in making or repairing jewelry can be annealed by heating to a cherry red color and then cooling. Nonferrous metals can be quenched in water for quick cooling and they will be dead soft. This process will not work on ferrous metals, especially high carbon steel. When it is heated a cherry red color and quenched, it becomes flint hard, which is part of the process in tempering steel. To soften a ferrous metal after heating it to a cherry red color, it must be slowly cooled and should be air cooled. A good way to slowly cool ferrous metal is to place it on a surface such as a fire brick or the bench heat pad used for soldering. This way the surface will not transfer the cold to the piece being annealed. The metal should never be placed on a cold surface for this could cause it to harden.

Using the rolling mill for reducing metals to proper thicknesses is something that needs to be done by steps that involve annealing. Each time the metal is run through the rolling mill it not only reduces the thickness but increases the length. After every third or fourth run through the mill, the metal will become harder. If annealed again at this point, metal can be further reduced as it is again dead soft. If not annealed often enough, the metal will become brittle and porous, and cracks will show on the edges. Metals have a grainy structure and when rolling the grains become elongated as the metal gets harder. When annealed, the grains return to their original shape. Although different metals and alloys have different annealing temperatures, the metals we use, mostly karat gold, silver alloys, nickel, and copper, are sufficiently heated if they turn a cherry

red color.

Care must always be taken not to overheat because this can cause the metal to melt. During the annealing process, always use a reducing flame which is the outer two-thirds of the flame of a torch. This will reduce the chance of oxidization on the annealed metal. Becoming proficient at annealing comes with practice and experimentation and knowing when to completely air cool and when to quickly cool by quenching. Quenching in room temperature water is ideal, and if you use a weak pickling solution it will remove any oxides that may have developed from the heating.

When reducing the diameter of wires by drawing them through a drawplate, annealing is most important. They should be annealed frequently; when you do so, it is amazing how small a piece of wire can be reduced from its original size, and the length to which it can be stretched. Karat gold, silver alloys, nickel, and brass are what we use most and they are easy to work whether it is with a drawplate, rolling mill, or by hammering and bending.

Annealing is also a necessity in doing jewelry repair. Often finger rings come in broken, and examination reveals that they have become hard and brittle and have broken as a result of being slightly bent. Such pieces should be annealed before repairing. Karat gold after having been soaked in chlorine water becomes brittle. Customers have brought in solid gold wedding bands that were in two or three pieces from being soaked overnight in Clorox. The broken ends showed they were porous. To repair such problems, the first step was to anneal the pieces, then gold-solder them back together. Even highly chlorinated swimming pools can be damaging to karat-gold finger rings. We are often called on to repair articles that have tempered steel springs which need to be bent or drilled. Sometimes these articles must be annealed, especially before drilling.

Being a watchmaker as well as a jeweler, I do my own case repair, which often requires making and repairing all kinds of springs. Annealing can be an important part of making these repairs. When learning to anneal metals, it is wise to practice on metals that, if ruined, will not matter. A good

way to start is to use a piece of brass or nickel silver wire that is hard. It can be recognized as being hard by bending it in the fingers and letting it spring back straight. Do not force it to stay bent but just test it for its springing ability. Then heat it to a cherry red color and quench it. You will notice that it will bend easily because now it is dead soft. Keep bending it back and forth, and notice how it gets springier as you continue bending. Eventually it returns to about the same springiness that it had before it was annealed. Experiment this way on larger pieces of metal until you have an understanding of how to anneal metals to meet the needs of repairing jewelry.

Using stretching and compressing tools to enlarge or reduce ring sizes is one of the best examples of when annealing is needed. If rings are work-hardened, they will break if stretched or shrunk very much. When annealed, rings can be stretched several sizes and reduced a size or more without damage. As an experiment, I took a size-5 ladies 2 mm, 14K gold plain wedding band and first annealed it. This was a new ring and being die-struck was already

work-hardened so it needed to be annealed before stretching. By annealing after stretching every two sizes, it was stretched to a size 12 without changing the shape of the ring except for making it much thinner.

Carbon steel, such as water-hardening tool steel can be annealed simply by heating it to a cherry red color and then air or slowly cooling it. This means that carbon drills, when broken off in drilling, can be annealed and then can be drilled out if other methods fail. If high-speed drills are used, these cannot be annealed and drilled out. Removing a broken high-speed drill can be difficult, if not impossible. When doing jewelry repair, most drilling must be done with drills smaller than one millimeter in diameter. I cannot find listings where these drills can be purchased in anything other than high-speed steel. When working on a delicate piece of jewelry great care must be used not to break the drill. Carbon drills, if subjected to enough speed and pressure, can create enough heat to be annealed. This ruins the drill. High-speed drills, even though heated almost red hot,

will not lose their hardness.

There is a temperature-controlled oven that will produce enough heat to temper (harden) or anneal metals, and also an instrument called a "Pyrometer" for measuring high temperatures. In the manufacturing business where much tempering and annealing is done, these tools no doubt pay for themselves. They aid in production and also in the quality of the work that is to be produced.

However, as a jewelry repairman with relatively small amounts of this kind of work, it would hardly pay us to make such an investment. The practical thing for us to do is learn to judge heat by colors, then we can do quality work at a fair price and still make a good living. Although I do read charts on temperatures and figures, I try to refrain from quoting them in my articles. I do this because my articles are based on my experiences, common sense, and logic. It works well for me and hopefully will for you also.

Pickling is a process that we in the jewelry crafting and repair trade find necessary and helpful. The term pickle, in gen-

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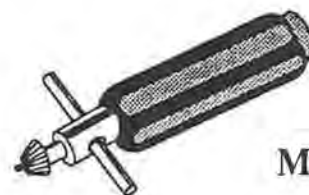


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Figure 1.



Figure 2.



Figure 3A. Sparex; Figure 3B. Sulphuric acid.

eral, refers to acid in some form. When working with jewelry metals, several kinds of acids are used.

Sulphuric acid is used in a diluted form for the removal of oxides that form from the applications of heat. The heat causes the metal to take on oxygen from the air which then forms a surface oxide on the metal. This oxide prevents the flow of solder so it must be removed. A solution of 10% sulphuric acid and 90% water makes a good solution for this purpose, especially if heated or boiled. For a cold solution, 20% acid and 80% water makes an effective solution. *In mixing full strength sulphuric acid (or any acid), always pour the acid into the water. Never pour water into concentrated acids because they will splatter and*

can be damaging to the skin, clothing, or other things they may contact. Other acids we find used in our trade are hydrochloric (muriatic) acid and nitric acid. These three acids can dissolve different metals so they should be used carefully. When using them, we must learn how they are most effective.

Sulphuric acid is good for pickling nonferrous metals but it will actually dissolve ferrous metals. When handling and immersing nonferrous metals into sulphuric acid, steel tweezers should not be used because they can be damaged by the acid. They will also pollute the acid, even in its weakened state. On my bench is a Pyrex tray containing a glass jar with a glass lid (see Figure 1). This is where the diluted acid is kept, and beside it is a glass jar containing tap water. The tap water is used, among other things, as a rinse after dipping or soaking any nonferrous article to remove oxides. Often, to quicken the pickling process, I use copper pickle pans which are made from copper pipe caps with brass rods silver-soldered to make a handle (see Figure 2). Then a wooden piece of doweling is added and held in place with brass hose caps. The articles to be pickled can be placed inside the pans and acid can be dipped from the jar of diluted solution, so it can be boiled over the flame of the torch. Boiling for less than a minute will produce the same results as soaking for ten minutes or more. When a hard solder joint is made on nonferrous metal with no stones, it can be dipped in the diluted acid while hot. This will pickle it completely and quickly.

The sulphuric acid is the old method for pickling but now there is an alternative which is a dry granular acid compound called "Sparex" (see Figure 3A). Sparex can be purchased from most any jewelry supplier. Directions on the can explain how to mix it with water. It can be used either hot or cold, the same as the diluted sulphuric acid. The "Sparex" substitute is non-inflammable, non-explosive, and safe to use in all ways. There is also available, a heated pickle pot which can be found in the suppliers' catalogs. If you are doing several hours of jewelry work, it is a real convenience because it will keep the solution hot for constant use. However, unless you are

doing a large quantity of jewelry work the method I previously explained will be satisfactory. Incidentally, in small appliance departments, you can find a small crock pot of about a quart capacity that works well as a pickle pot. The cost is minimal.

Make sure to always rinse any article immersed in pickling solution because even in its weakened state the acid can eat holes in clothing. Also, acid is not good for a person's skin. Any acid can be washed away with plain water so when contact is made with the skin or on clothes, rinsing immediately with water will stop its action.

Some of the other uses for the three aforementioned acids, other than for removal of oxides are:

Sulphuric — Dissolving broken screws in nonferrous metals if steel. Precleaning or cleaning stone set rings which have a build-up of soap or detergent residues under the stones. This can be done by soaking or boiling. Often regular cleaning solutions will not remove this residue, but after using the pickling solution the item will come clean in ultrasonic tank containing cleaning solutions.

Nitric — Used for testing for gold. Will dissolve most nonferrous metals such as copper, nickel, or brass but not gold. Also, when mixed with hydrochloric acid and water will make "Aqua-Regia" which will dissolve gold or gold alloys.

Hydrochloric (Muriatic) — Will remove soft solder from jewelry metals by dissolving the lead and other alloys in the solder. Dissolve zinc in the acid and this makes zinc chloride which is soft solder flux.

When dealing with acids always remember these are hazardous solutions and should be handled and stored as such. Although water will rinse the acid away it will not neutralize it. Baking soda will neutralize most acids.

In the next article we will discuss soldering, brazing, and welding. ☞

1996 CANDIDATES FOR AWI BOARD OF DIRECTORS

This year there are eleven candidates, from which five directors will be elected to three-year terms. The candidates are shown here. The five who receive the most votes will join the current board members during the annual Board Meeting, June 29-30, 1996.

During the month of April, the ballots and a background sketch of each candidate will be mailed to all AWI members eligible to vote. The election mailing will also contain the position of each candidate regarding this statement (candidates will respond in 300 words or less):

"Service and education are the main thrusts of AWI. As a director, I would propose the following recommendation."

A ballot return envelope will also be included in the mailing. The envelope will be addressed to the certified

public accountant who is responsible for counting the votes and certifying the outcome of the election.

All ballots returned must be in the ballot return envelope and postmarked on or before the deadline date that will appear in the voting instructions. Only marked ballots should be sent to the certified public accountant. Please do not include any notes or requests for information. The CPA must hold all ballots received until some time after July 1. AWI will be unable to answer any messages you might enclose until that time.

The future of AWI depends on the quality of the people the members select to serve as directors. Please take time to study the qualifications and positions of each candidate carefully when you receive the election mailing.



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Columbus, OH



Fred S. Burckhardt
Fort Worth, TX



Alice B. Carpenter
Tarboro, NC



David A. Christianson
Kendallville, IN



Dewey Clark
Glen Arm, MD



Gerhard M. Hutter
Palm Beach, FL



Gerald G. Jaeger
Sheboygan, WI



Jack Kurdzionak
Stoneham, MA



Dennis J. Warner
Springfield, MO



James E. Williams
Cortez, CO



Sue Ann Wysong
Austin, TX

TECHNICALLY WATCHES

ANTIQUE WATCH RESTORATION, PART CXXIV

OVERCOILED HAIRSPRINGS

By Archie B. Perkins, CMW, FNAWCC, FBHI

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The main purpose of the overcoiled hairspring is to improve the rate of the watch, especially the isochronal rate. When a watch is isochronal, its rate will be the same with different arcs of motion of the balance wheel. That is, when the mainspring is fully wound and the motion of the balance wheel is the greatest, the time will be the same as when the mainspring is almost run down and the arc of the balance wheel is very small. The time should not be affected by the degree of the arc of motion of the balance wheel whatever it may be.

Isochronism and the Flat Hairspring

Due to the nature of the flat hairspring, isochronism cannot be accomplished. This is because the center of gravity of the flat hairspring continually shifts during the breathing of the hairspring. The flat hairspring can be adjusted so that when it is at rest in the watch, its center of gravity is on center with the balance staff pivot. However, as the balance wheel starts moving and the hair-

spring expands and contracts, its center of gravity shifts away and toward the regulator pins. This is shown in Figure 1. View A shows a flat hairspring which is at rest or unstressed. In this state, it could be centered so the balance staff would stand in the center of its jewel holes without exerting any side pressure against the side of the jewel holes.

View B, Figure 1 shows the same hairspring in an expanded condition (unwound). Note that the coils opposite the regulator pins are wider apart than the coils on the side next to the regulator pins. This shifting of the body of the hairspring causes its center of gravity to shift from the center of the balance staff pivot toward the wide spaced coils and away from the regulator pins.

View C, Figure 1 shows the same flat hairspring which is in a contracted (wound) state. Note that the coils opposite the regulator pins are closely spaced. In this case, the center of gravity of the hairspring will shift toward the regulator pins on the same side as the regulator pins. This shifting of the center of gravity prevents a close isochronal rate. If a close isochronal rate is expected, the center of gravity of the hairspring must remain on the center of the axis of the balance staff. This can only be achieved with an overcoiled hairspring.

Isochronism and the Overcoiled Hairspring

The overcoiled hairspring was patented in 1779 by John Arnold (1735-1799) for his cylindrical chronometer hairsprings. An overcoil was applied to the flat spiral hairspring by Abraham Louis Breguet (1747-1823) some time after its invention by Arnold. The flat spiral with its overcoil is often referred to as a Breguet hairspring. The overcoil at this time was made and shaped so it gave the proper results without much thought of mathematical calculations. It was not until around 1858 that Edouard Phillips

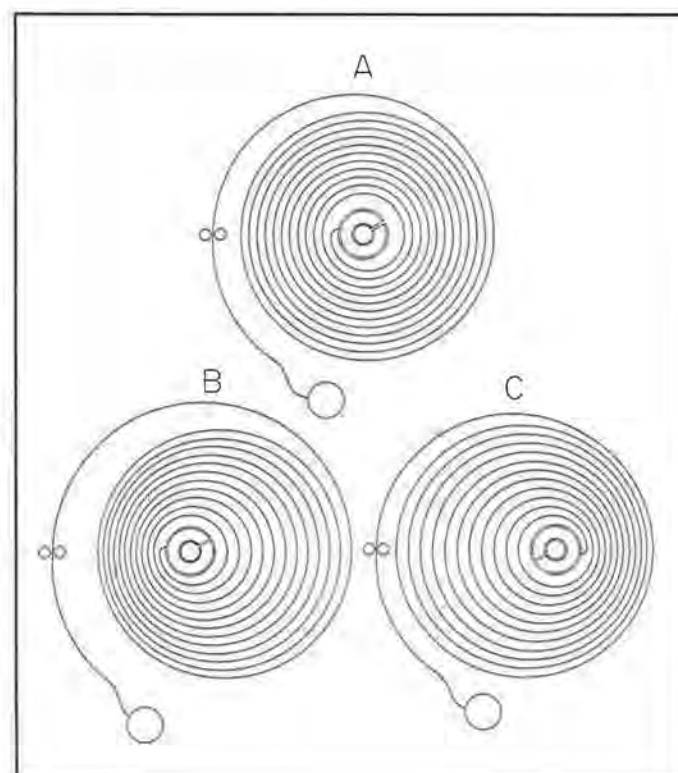


Figure 1.

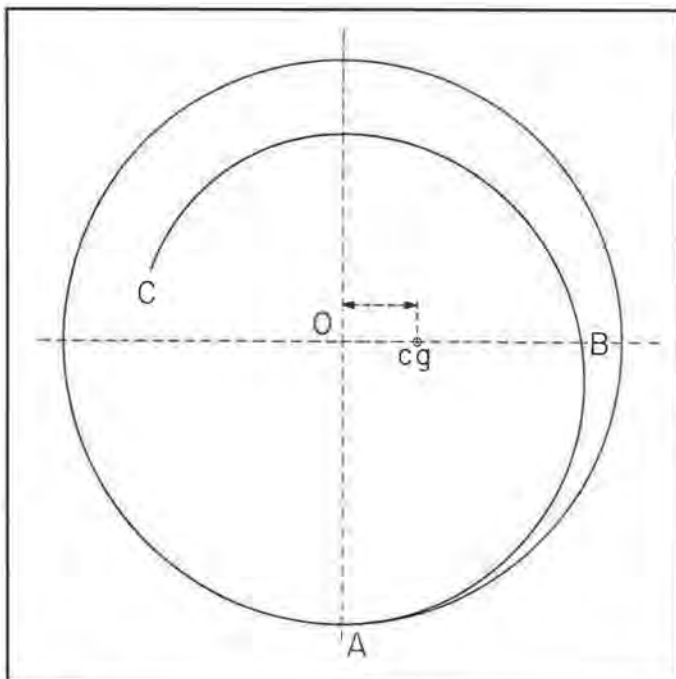


Figure 2.

(1821-1889), a mining engineer who specialized in metallurgy and springs, was asked to do a mathematical investigation of hairsprings. Phillips investigated mathematically the correct shapes of overcoils for hairsprings to cause them to expand and contract concentrically. This concentric development assures a close isochronal rate.

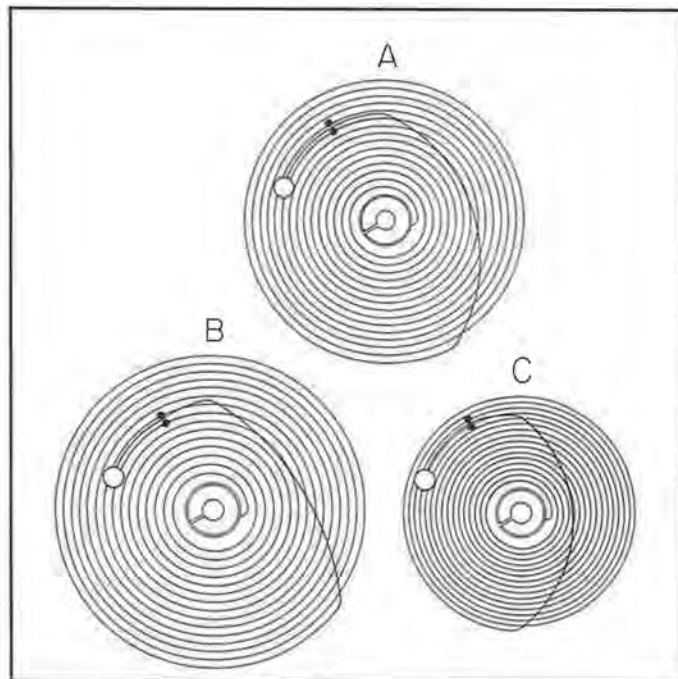


Figure 3.

The work of Phillips was published in the 1860s. Figure 2 is used to illustrate the Phillips theory of the overcoil. View O is the center of the hairspring. The distance ABC is the length of the overcoil, and cg is the center of gravity point.

The Phillips theory is:

1. The center of gravity of the curve should fall on line OB

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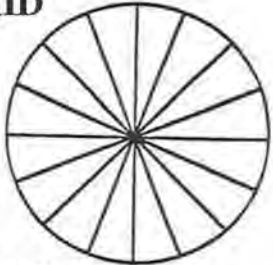
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which is a right angle to line OA that goes through the beginning of the terminal curve.

2. The distance from the center of gravity (cg) to the center of the spring must be equal to the radius of the spring squared, divided by the length of the curve.

$$\text{Then, } cg = \frac{OA^2}{ABC}$$

A terminal curve (overcoil) can be any shape as long as the center of gravity of the curve is at the correct position. When the overcoil is made theoretically correct, it may need to be changed slightly to fit the watch and to cause the hairspring to develop concentrically when the watch is running. A hairspring must breathe evenly in all radial directions for the center of gravity to be on the center of the axis of the balance staff. Only when this even breathing is present can we expect a close isochronal rate from a watch.

The overcoil must be formed with the least possible amount of bending. Otherwise, there will be stiff places and weak places in the overcoil which could affect the action of the hairspring even though the overcoil is at the correct place.

Figure 3 is used to illustrate how an overcoiled hairspring should act in the watch when the overcoil is made and adjusted correctly. View A shows an overcoiled hairspring which is at rest (unstressed). View B, Figure 3 shows the same hairspring in an expanded (unwound) position. Note that all of the coils are wider apart but are still evenly spaced. View C, Figure 3 shows the same hairspring in a contracted (wound) position. Note that the coils are closer together but still evenly spaced. This example shows that the hairspring is breathing evenly or expanding and contracting in an even manner. This indicates that the center of gravity of the hairspring is on the center of the axis of the balance staff. With this condition, we should have a close isochronal rate.

Figure 4 shows extreme hairspring conditions and how to adjust an overcoil for isochronal purposes. View B shows a hair-

spring with an extreme overcoil. This overcoil causes the short arcs of the balance wheel to be faster than the long arcs. An extreme overcoil like this causes the hairspring to breathe toward the hairspring stud or regulator pins if the watch has regulator pins.

View C, Figure 4 shows the other extreme in hairsprings. This is a plain flat hairspring which breathes to the side opposite the regulator pins. This condition causes the short arcs of the balance wheel to be slower than the long arcs.

View A, Figure 4 shows how to change an overcoil when adjusting the watch for isochronism. Any changes should be made to the first half of the overcoil. When the overcoil is shaped as shown in solid line and the watch is not isochronal, the following changes can be made to the overcoil. Suppose the short arcs of the balance wheel are faster than the long arcs. This would indicate that the overcoil is too long or the first half of the coil is too close to the balance staff. For major adjustments, the overcoil would be shortened by putting some of the overcoil back into the body of the spring as shown at "b" in View A, Figure 4 to slow down the short arcs. For minor adjustment, the first half of the coil is moved away from the staff without shortening the overcoil.

If the short arcs are slower than the long arcs, the overcoil is made longer or moved toward the balance staff as shown at "a," View A, Figure 4.

Shapes of Overcoils

After Edouard Phillips worked out the theory of the isochronal overcoil, others were involved in the design of overcoils. About 1890-95, Jules Grossmann (1829-1907) and his student Louis Lossier worked on the theory of overcoils and inner terminal curves at the hairspring collet. During this time, Louis Lossier designed an overcoil that has been used universally over the years. This overcoil is shown in Figure 5.

The design of the Lossier overcoil is simple and easy to re-

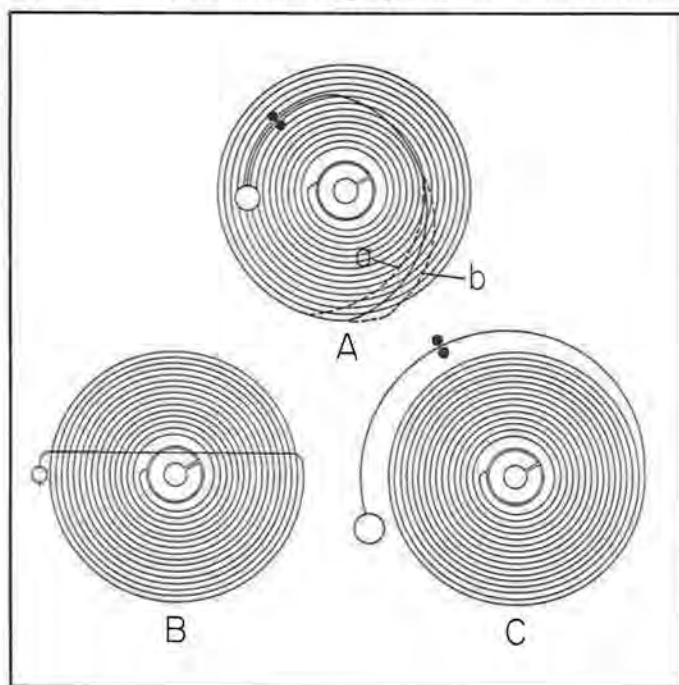


Figure 4.

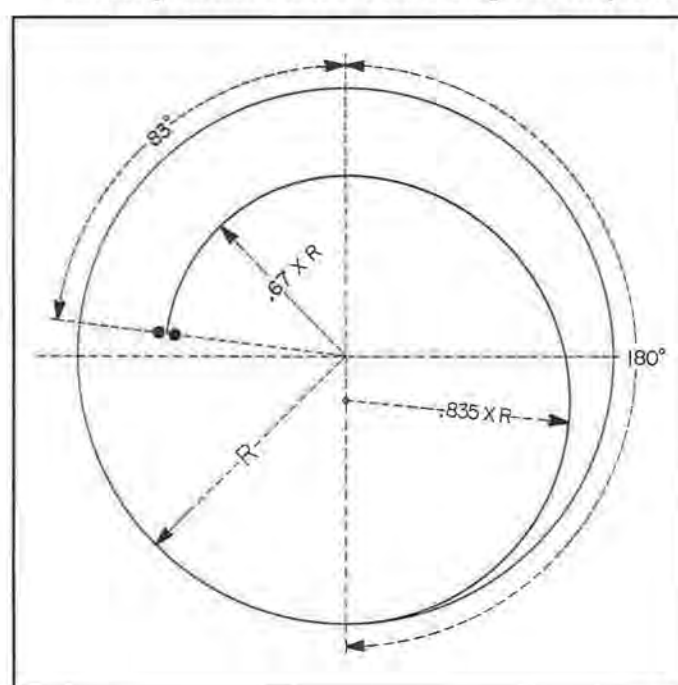


Figure 5.

Plate 1. Left Overcoils.

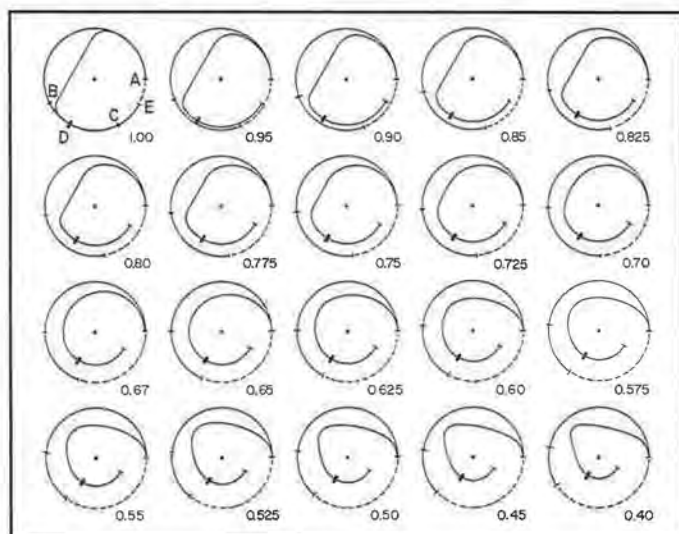
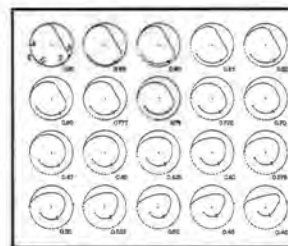
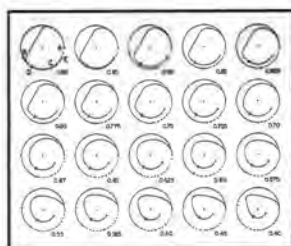
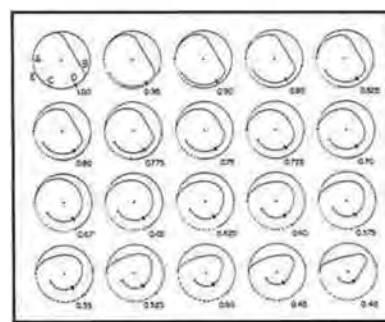
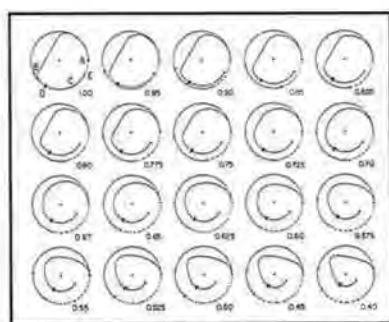
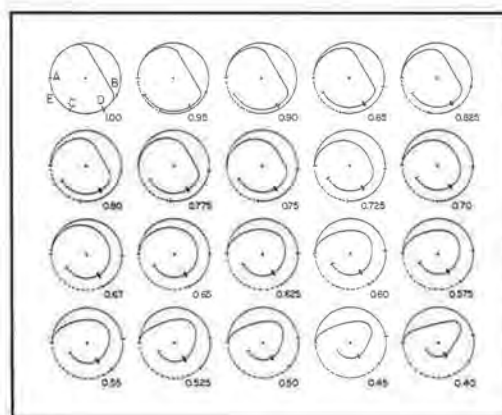
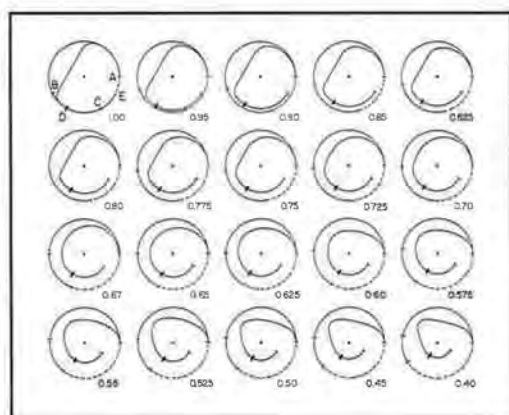
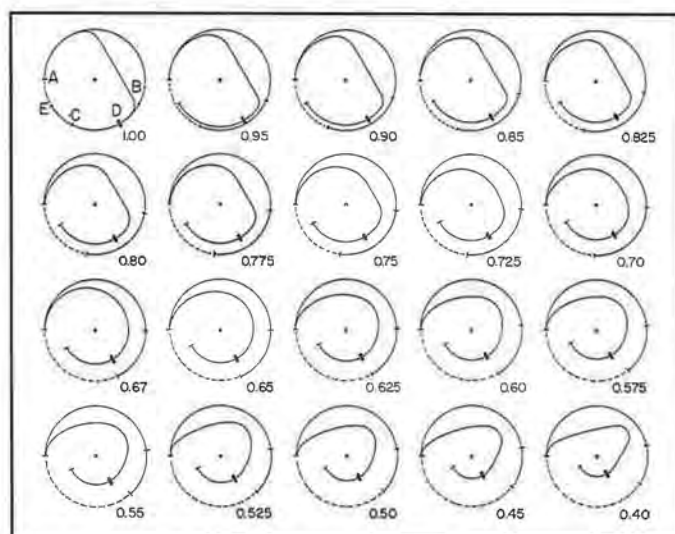


Plate 2. Right Overcoils.



produce because the overcoil is made up with only two curves that can be drawn with a drawing compass. The following is a description of the Lossier overcoil. The first 180° of the overcoil is drawn with a radius that is .835 X R (radius of spring). The last part of the coil, which is the regulator sweep part that ends at the regulator pins, is drawn with a radius of .67 X R. This section joins the first part of the curve and extends for 83°. Then, of course, the regulator sweep is extended enough to reach the hairspring stud. This extension was not used when calculating the shape of the overcoil. This overcoil was designed for a timepiece without regulator pins but it works equally as well with regulator pins.

Overcoil Patterns

The following overcoil patterns were drawn based on the coordinate tables in a book titled *Le Reglage De Precision* by C. Billeter. There are twenty patterns for left overcoils and twenty patterns for right overcoils. These patterns have been reduced in size in order to accommodate different diameters of hairsprings. They can be reduced still further if there is a need. These patterns range from a 100% regulator pins distance from center to a 40% regulator pins distance. It is very difficult to draw these patterns to exactness, but if an overcoil is turned to one of these patterns, you will be within the ball park, so to speak. Some final adjusting may need to be done in the watch afterward. When referring to the overcoil patterns, the following is an explanation of the different position points on each pattern. View A shows the start of the overcoil. View B shows the position of the regulator pins on the outside coil before making the overcoil. View C shows the posi-

tion of the end of the spring before the overcoil is made. View D shows the actual position of the regulator pins, and View E shows the end of the hairspring after the overcoil is made. (See Plates 1 and 2.)

Making an Overcoil Pattern

Figure 6 shows how an overcoil pattern can be made by the use of the tables of coordinates. First, a circle is drawn. Then, the circle is divided into 15° sections. Next, the degree lines are numbered starting with zero at the line where the overcoil starts leaving the body of the spring. Next, we start plotting the shape of the overcoil by using the figures in the table of coordinates. We have selected curve number 3 which has a .90 regulator pins distance. (See Table 1.) The table shows that for each 15° line there is a radius vector number that is multiplied by the radius of the circle representing the hairspring. This results in a radius point for the position of the overcoil at this particular radius line. The following is an example. The 15° line has a number of .99 mm. If we have a radius of 70.00 mm, then $.99 \times 70.00 \text{ mm} = 69.3 \text{ mm}$. Then a mark is made on the 15° line which is 69.3 mm from the center of the circle. Now, we go to the 30° line and calculate this distance. The table shows that for the 30° line we have the number .985. Then, $.985 \times 70.00 = 68.95 \text{ mm}$. We now make a mark on the 30° line which is 68.95 mm from the center of the circle. This process is continued on each line until the overcoil points are plotted. Then, the overcoil is drawn in through the points made on the degree lines.

The length of the overcoil measured on the outside circle from its start to the regulator pins position is 200° 30" or 200.5° for this particular overcoil. While forming this overcoil, the regulator pins position moves through an angle of 39° 30" or 39.5°.

"Antique Watch Restoration" will continue next month. ☞

Table 1.

Table of Polar Coordinates for Terminal Curves

Curve No. 3 0.90

Regulator Pins Distance = 0.90 X Radius of Spring

Angle of Degrees	Radius Vectors
0	1
15	0.99
30	0.985
45	0.975
60	0.96
75	0.94
90	0.87
105	0.68
120	0.565
135	0.51
150	0.495
165	0.52
180	0.58
195	0.71
210	0.89
225	0.90
240	0.90

Curve Development = 200° 30"

Continued on page 56.

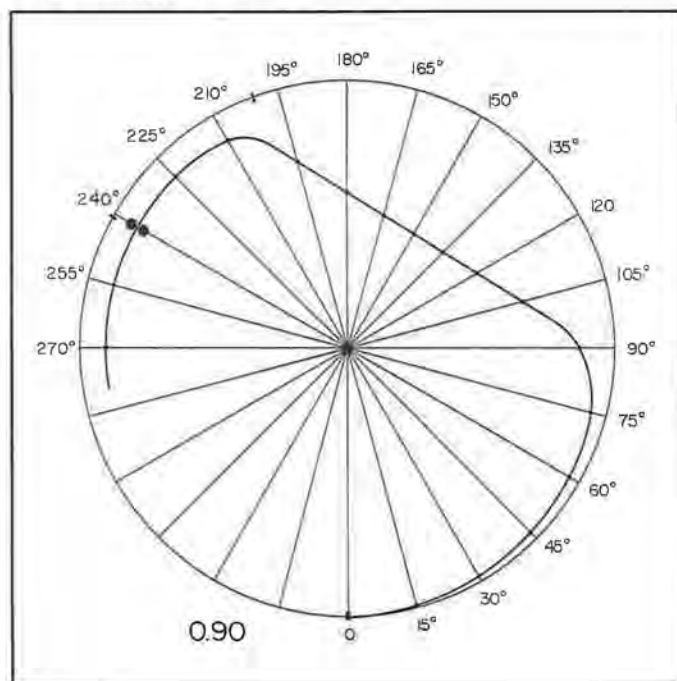


Figure 6.

OSU-OKMULGEE INITIATES CLOCK REPAIR CERTIFICATE PROGRAM

The Small Business Occupations Department at Oklahoma State University-Okmulgee announced recently that they are initiating a Clock Repair Certificate Program for a variety of student types, including advanced clock repairers, professional clock repair technicians, and entrepreneurs who have a desire to operate a clock repair service business.

"These courses will be taught throughout the academic year by instructor's who have years of experience in the field and will be designed to provide laboratory experiences in advancing technology. Upon completion of these courses, students will be issued a Certificate of Completion by the Department Head of Small Business Occupations at OSU-Okmulgee," says Jerry Wilson, Department Head.

The course currently being sponsored is a four-month hands-on learning experience which teaches students how to determine and make repairs to restore a clock to an operational timekeeper. They also learn how and where to order parts and supplies to accomplish the restoration process.

"Because some clock parts are no longer available, we also teach students how to fabricate clock parts by using jewelers and watchmakers lathe and other machinery or small hand tools. Additionally, we teach meticulous cleaning of the clock works. Lubrication, soldering, plus heat treatment of metal are all subjects a student learns during the course," says Hugh Dugas, Clock Instructor.

These courses give students the opportunity to disassemble, repair, and reassemble time only; time and strike; time, chime, and strike; and 400-day pendulum clock works. Both weight- and spring-driven works are used where applicable. Students are also introduced to such other clock works as Atmos, Fusee, Comptoise, Electrical, electronic and marine timepieces, including alarms.

Textbook references include the *Questions and Answers of and for the Clockmaking Profession*, AWI Press; *The Clock Repair Primer*, Balcomb; and the *Horolovar 400-Day Clock Repair Guide*.

Plans are now being finalized to offer the Clock Repair Program over a four to six semester period. Students who complete the total program should be qualified to pass certification examinations conducted by the American Watchmakers and Clockmakers

Institute (AWI).

OSU-Okmulgee is targeting a national audience and expects to have students from the central part of the United States enroll in these courses. A liaison relationship is being proposed with AWI to develop a clock repair curriculum that will yield a world class professional/technical clock repairer here in the United States.

Scheduled for the Summer '96 semester is the Fundamentals of Clock Repair and the American-made Time and Strike Clock Course. The fundamentals clock repair course is designed to teach the basic techniques associated with utilizing hand and power tools that are commonly used in clock repair. Topics will include shop safety, filing, sawing, and soldering techniques; metric system of measurement, metallurgy techniques, lathe and turning techniques; gravers, milling, pivoting, gear tooth manufacturing techniques; and staking tools.

The American-made Time and Strike Clock Course will teach clock nomenclature. Other topics will include disassembly and assembly techniques; inspection and troubleshooting techniques; and cleaning, repairing, and adjusting techniques. Students will learn how to polish pivots, replace gear teeth, repivot, rebush, make tension springs, produce new control wires, and restoration techniques.

Other series of the Clock Certificate program include Chiming Clocks and 400-Day Anniversary Clocks, Advanced Clock Repair, Complicated Clock Repair, and Restoration Techniques for Clock Repair.

Approximately ten students are now enrolled in the Clock Repair Program. OSU-Okmulgee also sponsors a Watch and Micro-instrumentation Repair Program and has modeled a curriculum after the WOSTEP II program that provides approximately 3,000 clock hours of laboratory time.

Classes start in January, April, and August. OSU-Okmulgee's mission is advancing technology. They are located thirty miles south of Tulsa, Oklahoma. Financial aid and a residence campus are available.

For more information on course schedules, contact: Small Business Occupations Department, OSU-Okmulgee, 1801 E. 4th St., Okmulgee, OK 74447. Phone: (918) 756-6211, ext. 271.

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MUSIC BOX CLOCKS

TWELVE-TUNE MUSIC BOX WITH SIX BELLS, PART 9

By Leo A. Jaroslaw

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Introduction

In Part 8 we completed removal of the comb. We will now continue to disassemble the movement.

Mainspring Let Down

Remove female geneva stop (57). (See Figure 9.1.)

NOTE: The purpose of a geneva stop, for those who may not be familiar with it, is to limit the number of turns that can be applied to winding the mainspring. It is set to stop before the spring is fully wound on one end. It also prevents a complete rundown of the spring and the possibility of the spring becoming unhooked from the arbor. When properly setup the lock allows the spring to work in the most effective range of the spring.

The geneva stop or lock as it is sometimes called, consists of two components: a male geneva stop (56) and a female geneva stop (57) (See Figure 9.1.) The male is fitted to the spring arbor (58) and therefore turns with it. The female is a disk with a number of slots (61) around its circumference. The number would depend on the number of turns in the design of the mainspring assembly. The female is free to rotate on the shoulder screw (59).

The area between all but one pair of slots on the female is concave with a radius equal to the curve of the circumference of the male. This allows the male to rotate without engagement with the female until the stop finger (60) enters the slot (61).

As it continues to rotate, the male drives the female around until the male stop finger comes out. The next slot is now lined up to receive the male extension on its next rotation. After the designed number of rotations of the male disk/spring arbor, the male body contacts the convex section of the female disk. As the male cannot move it is effectively stopped. The same action takes place in unwinding.

NOTE: The female geneva stop can only be removed when its position is in the upper half of the spring barrel (26). It must also be free of the male stop finger (60).

If the female geneva stop is not in the correct position, complete the following steps.

8.1. Temporarily re-attach the winding lever. (See Figure 9.5.)

8.1.1. Wind spring one or two ratchet steps at a time. Release the governor. Repeat as necessary until the female geneva stop is in position to be removed.

8.1.2. Remove female geneva stop.

8.2. Run movement until the spring is completely wound down.

NOTE: When spring is completely run down, there will be freedom of movement between the spring barrel main wheel and the cylinder drive wheel.

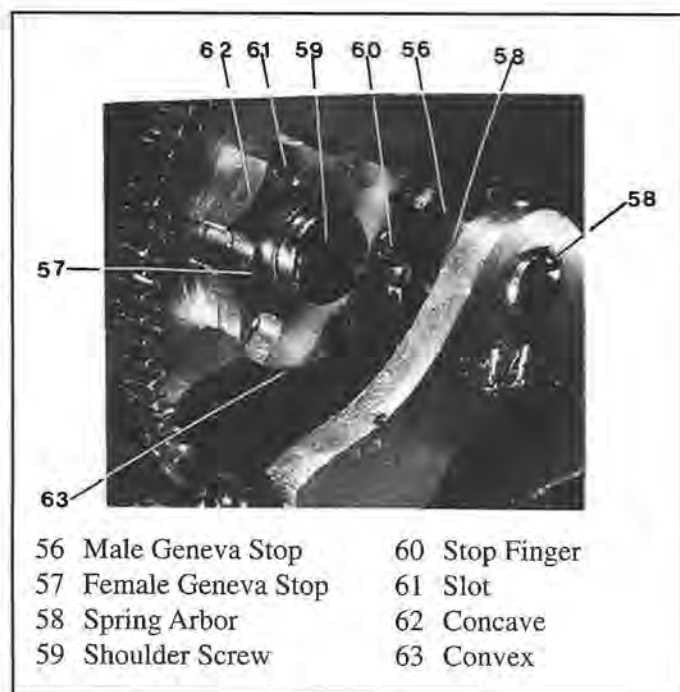


Figure 9.1. Geneva stop assembly.

If the spring cannot be run down because of some governor problem or other bind, it will have to be let down.

8.2.1. On a key-wound music box, the procedure is exactly the same as you would use in letting down a clock mainspring.

CAUTION: MUSIC BOX MAINSPRINGS ARE ALMOST ALWAYS MORE POWERFUL THAN MOST CLOCK MAINSPRINGS. THE EXCEPTION WOULD BE ENGLISH BRACKET CLOCK FUSEE SPRINGS WHICH ARE SIMILAR IN WIDTH AND STRENGTH TO MANY MUSIC BOX MAINSPRINGS.

8.2.2. On a lever-wound movement, release the upper click (28) and bring the lever (9) back until up straight, engage click. (See Figure 9.5.) Pull lightly on lever and release lower click (113) allowing spring to unwind pulling lever down. Engage lower click. Repeat till unwound.

NOTE: As found, the female geneva stop was miss-

ing and the male damaged. (See Figure 9.2.) The work required to replace the damaged geneva stop will be described later in Part 16.

9. Remove governor and set aside. (See Figure 9.3.)

NOTE: The governor is attached to the bedplate by a screw (64) through the governor block (20). Alignment is accomplished by two dowel pins (65) in the block which mate with holes in the bedplate (66).

NOTE: The governor attachment described above is for the later movements. In the earlier governors the screw came up through the bedplate and threaded into the governor block.

NOTE: The later governors were of two types. One, the governor on the movement we are discussing, has a cutaway section (67) on top of the governor bracket (18). This provides access for a screwdriver directly to the attaching screw.

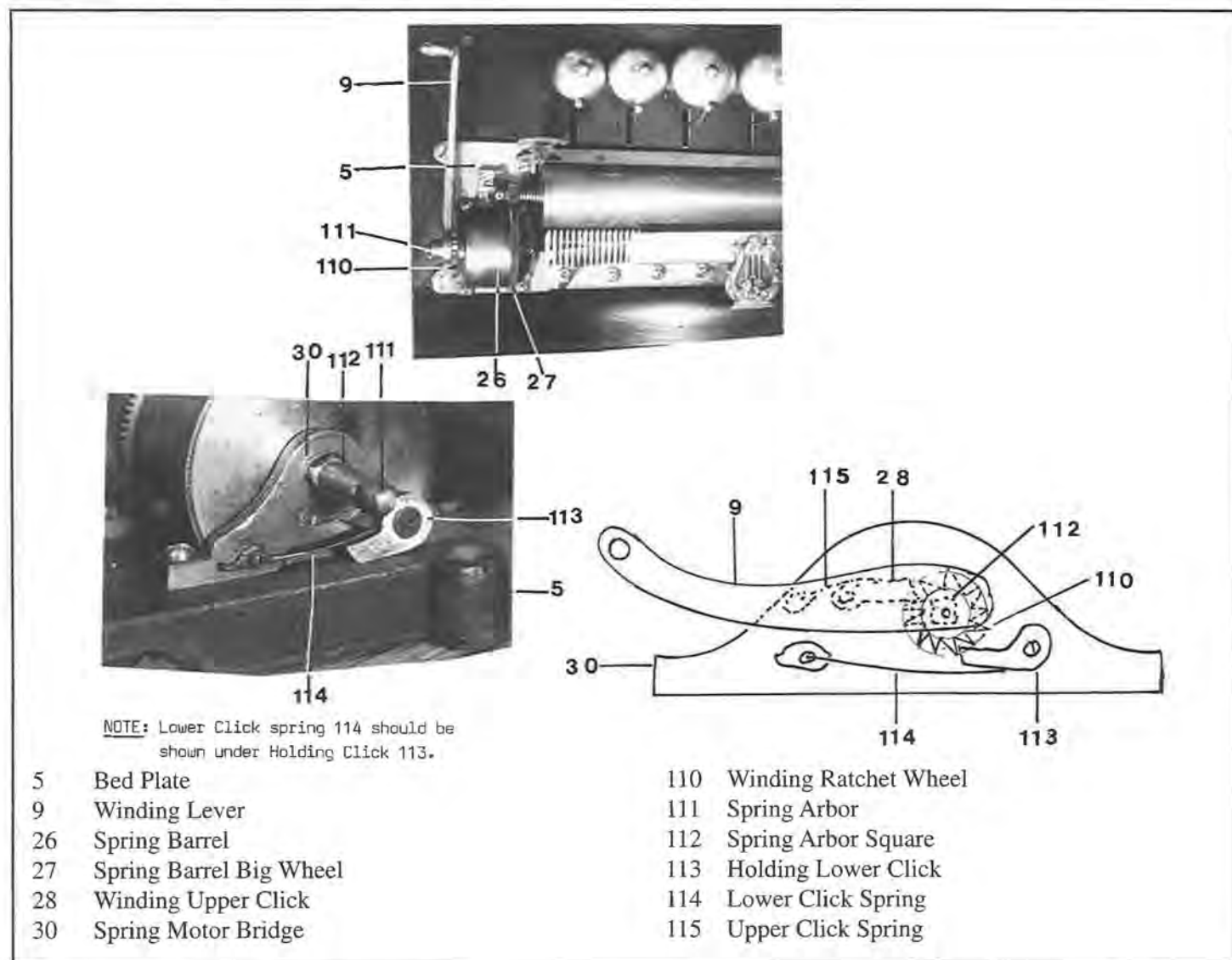
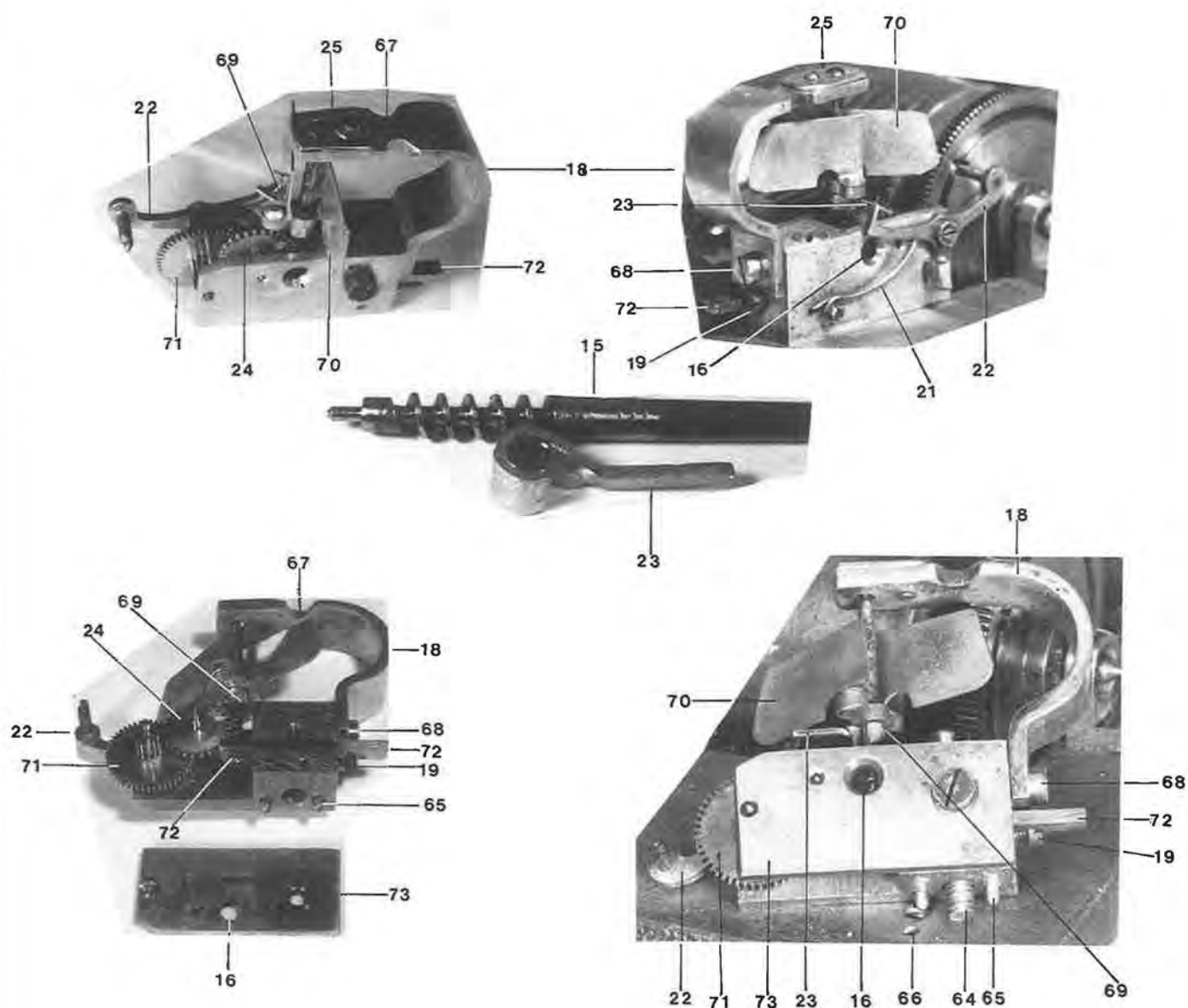


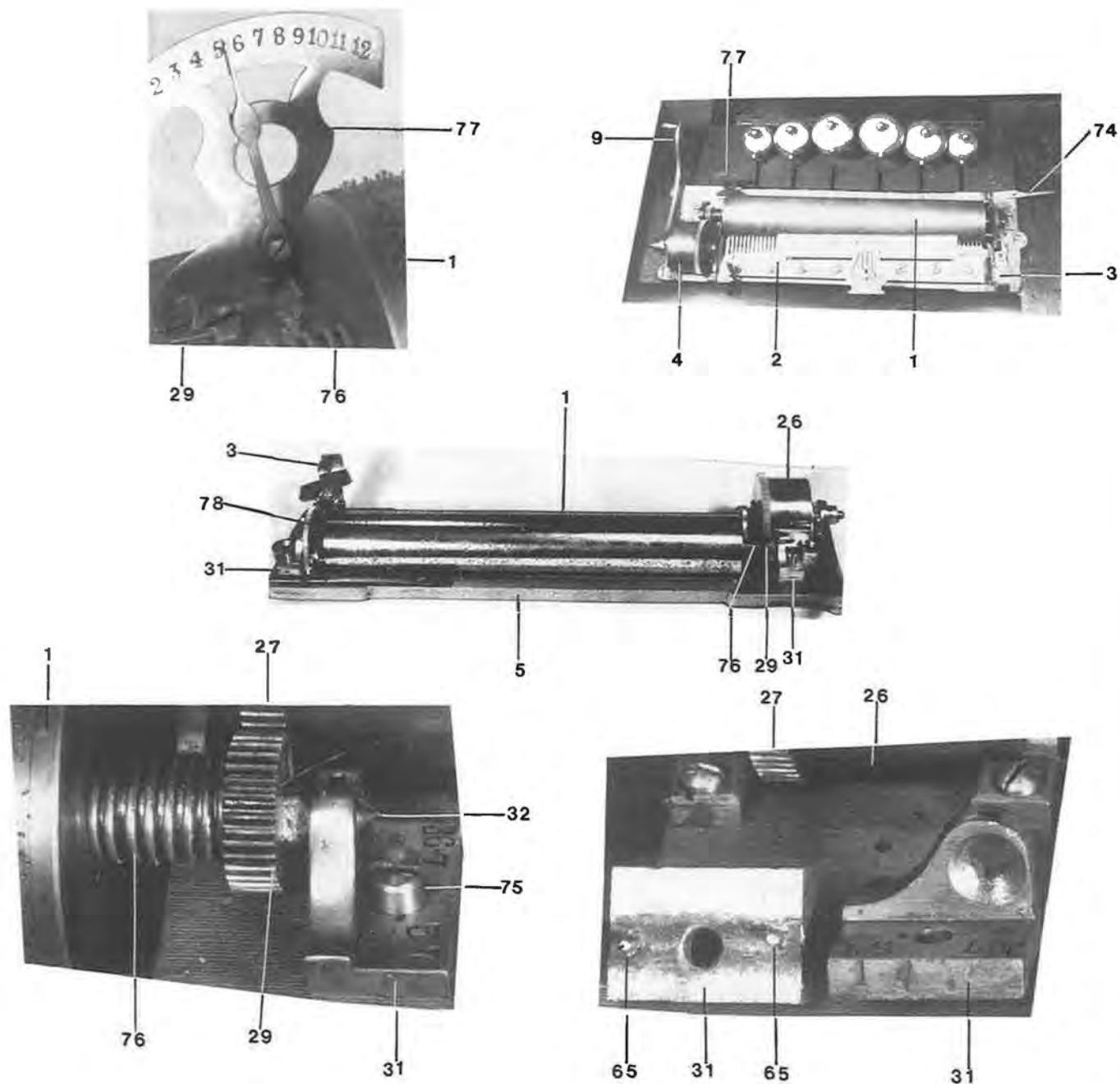
Figure 9.5. Spring motor winding components.



- 15 Endless Screw/Arbor
- 16 Endless Screw Peep Hole
- 18 Bracket
- 19 Adjustable Bearing Screw
- 20 Governor Block
- 21 Stop Spring
- 22 Stop Arm
- 23 Stop Tail
- 24 Worm/Middle Wheel
- 25 Jewel Plate

- 64 Governor Attaching Screw
- 65 Dowel Pin
- 66 Governor Locating Hole
- 67 Screw Access Cutaway
- 68 Bracket Attaching Screw
- 69 Endless Screw/Fan Assembly
- 70 Adjustable Fan Blades
- 71 First Wheel
- 72 Adjustable Lower Bearing
- 73 Block Side Plate

Figure 9.3. Governor and components.



- | | | | |
|----|-------------------------|----|------------------------|
| 1 | Cylinder Assembly | 29 | Cylinder Drive Wheel |
| 2 | Comb Assembly | 31 | Cylinder Bridge |
| 3 | Governor Assembly | 32 | Cylinder Arbor |
| 4 | Spring (motor) Assembly | 65 | Dowel Pin |
| 5 | Bed Plate | 74 | Change/Repeat Lever |
| 9 | Winding Lever | 75 | Cylinder Bridge Screw |
| 11 | Tune Change Control | 76 | Cylinder Return Spring |
| 26 | Spring Barrel | 77 | Tune Indicator |
| 27 | Spring Barrel Big Wheel | 78 | Cylinder Great Wheel |

Figure 9.4. Cylinder assembly control and indicator.

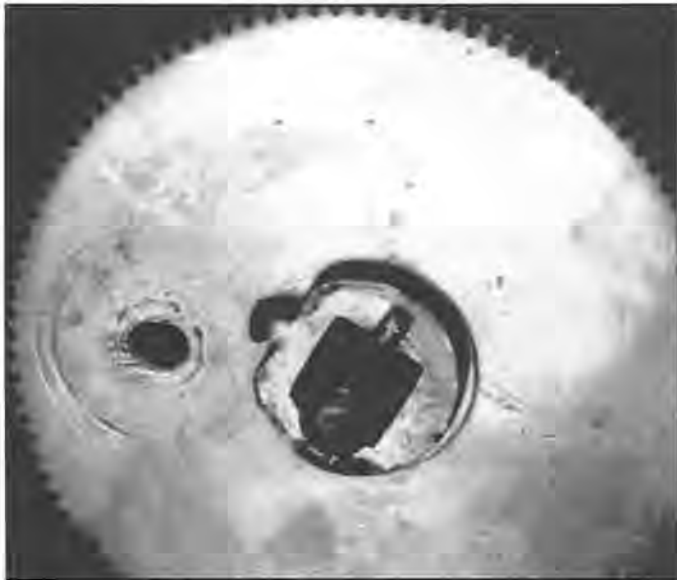


Figure 9.2. Geneva stop as found.



Figure 9.6. Temporary storage of cylinder.

The other type has a solid top on the governor bracket. To gain access to the mounting screw, it is necessary to remove the bracket. The bracket is attached to the governor block with a screw at the lower end (68). (See Figure 9.3.)

CAUTION: WHEN REMOVING THE GOVERNOR BRACKET, CARE MUST BE TAKEN TO PREVENT DAMAGE TO THE ENDLESS SCREW/FAN ASSEMBLY (69).

10. Remove cylinder and set aside. (See Figure 9.4.)

NOTE: The cylinder is mounted between brass bridges (31) at either end. These bridges, as with most others on this movement, are located with dowel pins (65).

- 10.1. Remove tune indicator (76).
- 10.2. Remove change/repeat lever (74).
- 10.3. Remove cylinder bridge screws (75).
- 10.4. Lift cylinder and bridges off the bedplate. Leave bridges on the cylinder arbor at this time.

NOTE: It may be necessary to pry up the bridges, depending on the fit of the locator dowel pins.

CAUTION: WHEN LIFTING THE CYLINDER, GRASP IT BY THE DRIVE WHEEL ON ONE END AND THE GREAT WHEEL ON THE OTHER END.

- 10.5. Wrap cylinder.
- 10.5.1. Remove bridges.

NOTE: I had available some 1/2" foam sheeting. I used that to wrap and protect the cylinder, then placed it in a box (see Figure 9.6). You could also use any plastic foam sheeting, bubble wrap, corrugated card board, or if nothing else is available, several layers of newspaper. These must all be at least as thick as the length of the pins to protect them. The purpose of the wrap is to protect the cylinder pins while the cylinder is set aside until it is to be worked.

11. Remove spring barrel assembly. (See Figures 9.1 and 7.1, View D—Feb. '96.)

11.1. Loosen and remove the four screws attaching the motor bridges (30).

NOTE: Some of the books on music boxes refer to the spring barrel assembly as a motor. I will use the two terms interchangeably.

The motor bridges on this movement are the only bridges without locating pins.

- 11.2. Disassemble and remove winding lever, if not removed previously.
- 11.3. Remove male geneva stop (56).
- 11.4. Remove motor bridges. Set aside.
- 11.5. Set aside spring barrel.

NOTE: This completes the basic disassembly. As we continue, we will describe each component and procedures in the recommended order.

In the next part we will start cleaning.



EDUCATION

UPDATE

by James E. Lubie

First of all, I would like to take this opportunity to thank another local member for his time and hard work. Donny Fox has done an excellent job cleaning and polishing all the punches and stumps in thirteen sets of K&D staking tools and thirteen sets of Seitz Jeweling tools. These tools will be used by the students of the Academy of Watchmaking beginning July 15, plus they will be available for members to use during any of the Project Extend classes. Thanks again Donny for all your help.

You will notice several changes in the schedule for Project Extend classes in this month's issue of *Horological Times*. We have combined the schedule of the Academy of Watchmaking with the watchmaking courses of Project Extend. This will allow us to disregard any minimum registration concerning courses related to watchmaking. You will be able to participate in any of the published watchmaking courses, even if you are the only one interested. Next month we will publish the new schedule for clockmaking courses complete with several new and improved classes.

Henry Frystak, renowned Bulova Accutron expert and instructor, is scheduled to teach a one-week course on the

Bulova Accutron, June 10-14, 1996, here at Project Extend. We do have a few members registered, but there is still plenty of room for others who have been waiting for this training. Mr. Frystak will take you through the Accutron 214, 218, 221, and 230. Don't miss this opportunity to learn from the expert.

There are plenty of spaces available in all the other Project Extend and Bench Courses scheduled for May and June. Check the schedule for subjects that in-

terest you at Project Extend, and for Bench Courses near you. Remember the ELM Trust has grants available for Project Extend students.

Pictured below are two students from Roy Hovey's recent course on the micro lathe which took place in Minneapolis, Minnesota. Everything is now in place for the more advanced "Cross Slide" course to take place June 7-9, 1996, also in Minneapolis. If you are interested, there is space available. ☛



Figure 1. Mike Mishou works on a great wheel during the Micro Lathe Course in St. Paul, Minnesota.



Figure 2. Susan Wood works on a great wheel during the Micro Lathe Course in St. Paul, Minnesota.

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A BLACK FOREST CLOCK & MUSIC BOX

By David J. Carlson

The very impressive Black Forest clock shown in Figure 1 was brought into the shop. The overall dimensions are 35" tall, 28" wide, and 15" deep. The clock is made in two parts: the upper section is a finely carved statue of a hunter carrying a double-barreled shotgun with a visible escapement French clock mounted immediately below the statue, and the lower section is a carved base which contains an eight-tune music box built by B. A. Bremond. There is a hinged door at the rear of the base which may be opened to enable a louder sound and to access the tune sheet which lists the eight tunes in French.¹ On the left side of the base there is a hole for the music box winding crank. On the right side of the base, control of the music box is provided by two levers. The first lever has two positions: repeat the tune or "Change the Airs;" a second lever provides three positions: "Music at Pleasure," "hrs," and "Silence Lock." Judging by the music box, the clock was most likely built in the 1870s.

As received, the alarm system to start the music box had been removed from the French clock. The music box would not start reliably, and the mechanism to provide the play on the hour had been removed from the music box. The owner wanted the system restored. The project proved to be a formidable challenge.

French Clock

The visible escapement French clock was taken down, cleaned, lubricated, and reassembled. An important part of the assembly was the restoration of the alarm system for the music box which consisted of two levers and an arbor. Fortunately these pieces were found in the base of the clock.

Hour Signal

The signal or alarm to start the music box is derived from a system of two levers and a pin in the minute wheel. The front plate of the clock is shown in Figure 2 with the minute wheel in place and the lever immediately behind it. When the cannon pin-

ion and hour wheel are put in place, the timing is set so that the minute wheel pin allows the lever to fall two minutes before the hour bell strike. The rear plate is shown in Figure 3 with the lever and spring. Not visible are two pins. One pin is attached to the lever and rests on the spring. The second pin is a stop pin in the back plate which limits the upward movement of the spring. Figure 4 is a view of the completely assembled movement with the pendulum and "signal" weight in place. The value of the weight is critical for two reasons. First, the spring on the back plate in Figure 3 must support the weight of the assembly at a position which enables the lever on the front plate in Figure 2 to intersect the minute wheel pin. The second reason is that the weight must be heavy enough to provide sufficient impulse energy to key the music box. After some experimentation, 15 grams was selected for the "signal" weight assembly which was well within the adjustment range of the rear spring and sufficient to key the music box.

Operation

At ten minutes to the hour, the pin on the minute wheel starts to lift the front lever which in turn lifts the rear lever. At five minutes to the hour, the lever is approximately at the halfway lift position at which point the spring on the rear plate hits the stop. The rear lever continues to rise until two minutes to the hour when the front lever drops off the minute wheel pin and simultaneously the rear lever and signal weight are released. As the rear lever falls it picks up the spring which deflects downwards allowing the weight to deliver an impulse to the music box trip lever at the bottom of its travel. The spring causes the weight to "bounce" back and the levers are again in position for the next cycle. In principle this action is similar to the "surprise strike" which is used in some European clock designs.

Music Box

As received, the music box had

"An important part of the assembly was the restoration of the alarm system for the music box which consisted of two levers and an arbor."



Figure 1. Black Forest clock.



Figure 2. Front plate with control lever.



Figure 3. Rear plate with control lever.

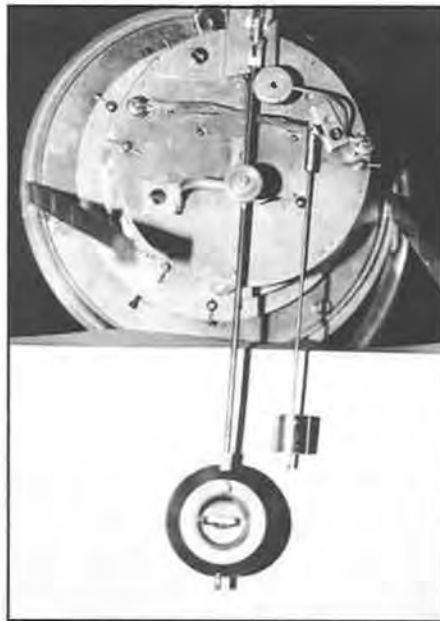


Figure 4. Complete clock assembly.



Figure 5. Governor taken apart.



Figure 6. External control levers.

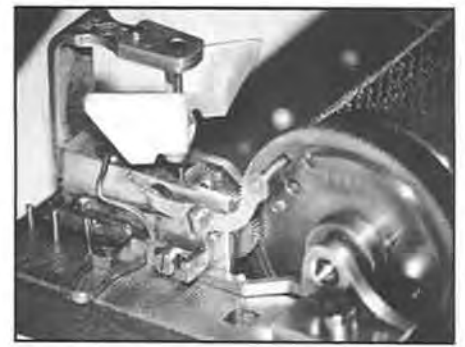


Figure 7. Music box control levers.

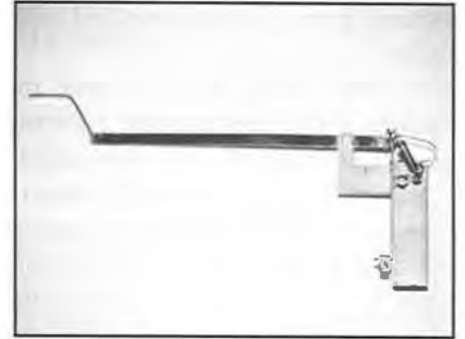


Figure 8. Music box trigger system.

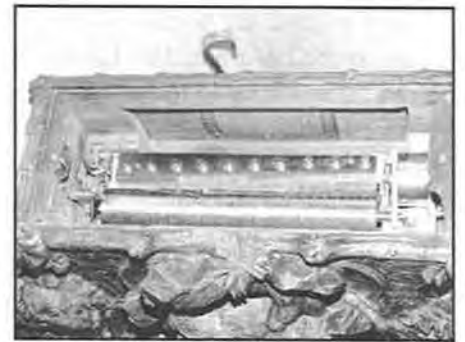


Figure 9. Music box with control system.



Figure 10. Eight music box airs.



Figure 2. The domed flexible crystal of varying heights.



Figure 3. The round press-on crystal: the straight-sided crystal fits snugly over the raised rim on the case frame.



Figure 4a. The bezel ring then fits tightly around the outside of the crystal creating a sandwich in which the outer bezel ring holds the crystal firmly against the inner rim of the case frame.



Figure 4b. Locked in place with the crystal press.



Figure 5. Round cylinder crystal: straight-sided crystal, hollow in the inside to give room for the watch hands, snaps into the straight-sided watch bezel.



Figure 6. Sealed in place with crystal cement applied around the circumference of the bezel recess.



Figure 7a. Measure the inside of the bezel to get the needed size; in this case the crystal bezel is part of the case frame and takes a round cylinder crystal.



Figure 7b. This case uses a press-on crystal. Measure the outside diameter of the case rim and the inside diameter of the separate crystal bezel.



Figure 8. In very inexpensive watch cases, the crystal that fits snugly over the case frame rim has walls too thin for the outside bezel to fit firmly around the outside of the crystal and hold the crystal in place. Primarily because the crystal (with thicker walls) is not available as a replacement crystal.



Figure 9. On many of these inexpensive watch cases, where a genuine replacement crystal is not available, pick a generic replacement crystal that fits snugly into the crystal bezel ring and then cement the bezel and crystal to the case frame by applying an epoxy around the case frame rim.



Figure 10. Seiko two-part crystal epoxy: a flexible, resilient epoxy for sealing loose crystal to case frames. Works especially well for filling in gaps created by a crystal that is too loose a fit in the case. Yet this epoxy can be easily removed by heating the case and crystal.



Figure 11a. Three other styles of press-on crystals in addition to the rim style.



Figure 11b. A small sampling of the sizes and shapes of press-on crystals available.



Figure 12a. The typical armored (tension ring) crystal.



Figure 12b. Various styles of tension ring crystals: the thin type on top is for thin watches, the domed style in Figure 12a along with the flat top and beveled edge types are more for looks.



Figure 13. Tension ring crystals fit only in bezels that have straight walls.



Figure 14. Bezels with angled or beveled walls require only the flexible type crystals.

The **round press-on crystal** has received much less attention (albeit some). This crystal comes in two significant types: the domed press-on and the cylinder press-on. The most common press-on crystal is called a “ring style” and is generally pressed onto a raised lip on the case frame with finger pressure (see Figure 3); and is then held in place with a bezel ring that presses around the crystal’s perimeter using a crystal or case press (see Figure 4). The **round cylinder crystal** is straight-sided and typically presses onto or snaps into a straight-sided bezel recess (see Figure 5), although I find that a bit of crystal cement applied to the bezel recess (see Figure 6) gives a much better permanence. In either situation, measure for a tight fit. Measure the inside diameter of the bezel ring to get the size needed. You’ll find the sizes that are available listed in your crystal catalogue. On some of the very inexpensive watch cases of this style, a replacement with a tight fit around the case ring is too thin in the crystal wall to hold the bezel ring that is supposed to press on around the outside diameter of the crystal (see Figure 8). In this case the

only way to replace the crystal is to pick one that fits firmly within the bezel ring and then cement the crystal and bezel ring onto the case frame (see Figure 9) using a resilient crystal epoxy such as the Seiko S-310 (see Figure 10).

In addition to this “ring style” press-on crystal, there are three other styles of press-on crystals available: the magnifier, the flange, and the lip flange. The three are available in a rather limited range of sizes and are all listed in your crystal catalogue by outside millimeter diameter (see Figure 11).

The **armored or tension ring crystals** have also been covered quite well in the literature; again, Henry Fried’s *Watch Repairer’s Manual*, along with Archie Perkin’s and Wes Door’s articles in *Horological Times* give excellent instruction on these crystals. (See Figure 1.) However, a couple of comments are in order. Armored crystals come in several configurations; domed, domed with magnifier, flat top, flat with beveled edges and very thin for very thin watches (see Figure 12). Keep in mind that these crystals fit only in bezels that have straight walls (see Figure 13); the bezels with angled



Figure 15. Cases with a wide gap between bezel and dial edge require a wide tension ring to keep the dialed movement in place.



Figure 16a. A “stepped” tension ring is required to hold some movements in place.



Figure 16b. In some thinner watch cases, the dialed movement sits above the crystal seat. This is done to give a deeper wall for the crystal to seat against. The stepped tension ring provides a wider pressure surface on its outer diameter and a recessed step to hold the movement in place.



Figure 17. Removing decorative bezel ring using a folded piece of poly bag to protect the case finish. This bezel ring also provides protection for the upper portion of the armored or tension ring crystal. The crystal itself seats on the inside of the case frame as in Figure 16 using a stepped tension ring to hold the movement.



Figure 18. Removing old crystal by pressing outward from the inside of the case frame.

or beveled walls require the flexible type crystals (see Figure 14).

The tension rings in armored crystals vary, also, and can be an important issue. Some watch cases and their respective dials require a crystal with an extra wide tension ring (reflector ring) to span the gap between dial and case frame (see Figure 15). Other watch cases and their respective dials require a stepped tension ring to hold the recessed dialed movement in position (see Figure 16). In either case extra wide rings are available to fit any tension ring crystal, and stepped ring armored crystals are also available in many diameters.

1. Actually, about twenty-three articles related to crystals have appeared in *Horological Times* over the past sixteen years. Many of these offer miscellaneous hints and tips of value. (See Figure 1B.)

IN MEMORIAL



Joseph "Joe" C. Crooks, Jr.
1919 - 1996

Joe Crooks served two terms as President of AWI, 1980-1981 and 1981-1982. He was best known for his "country boy" wit and humor and his laid-back approach to solving problems.

Joe was blessed with a wealth of natural mechanical ability and an inquisitive mind that prompted him to experiment and find a better way. "Jingle Joe" Crooks began writing a "Bench Tips" column for AWI soon after *Horological Times* was born. At that time he was Technical Director of the North Carolina Watchmakers Association and penned his original Bench Tips for their newsletter. A book of the complete collection of Joe Crooks' bench tips is just about to go to press.

Joe Crooks lived in Mooresville, North Carolina, where he operated Joe's Watch Shop until illness forced him to give it up recently. He is survived by his wife, Peg Crooks; a son, Joseph C. Crooks III; a daughter, Joanne Barrier; a sister, Christine Daves; and three grandchildren and one great-grandchild.

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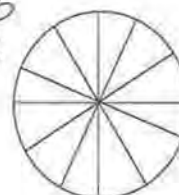
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HEAT TREATMENT OF STEEL

J.P. Kenyon, CMC

Metals used for the manufacture of clock movements are carefully chosen in respect to their physical properties, on the basis of the function they are intended to achieve. To meet certain physical specifications, some metals require additional improvements in their microstructure. Steel can be put through a process of heat treatment involving a combination of controlled heating and cooling operations to adjust its properties in respect to hardness, toughness, and wear resistance. The various methods of heat treatment are explained below, with the recommended procedure of each technique.

Physical properties of steel can be adjusted to fit the requirements of a part by techniques known as hardening, tempering, and annealing.

Hardening

The most important heat treatment is hardening. This technique renders the maximum physical properties in respect to hardness, strength, and wear of steel. The process consists of heating the steel to a temperature well over the "critical range" and cooling it rapidly in water or oil.

The "critical temperature" is the temperature to which steel must be heated so it will harden properly when cooled by quenching. This temperature varies with different kinds of steel. The higher the carbon content, the lower the "critical temperature" needed for hardening. High carbon steel is hardened by heating it to a "dull red" (about 1200 degrees F.) and then quenching it into a liquid to cool it quickly. Refer to Table 1 for color/temperature relationships used in hardening steel.

The temperature to which steel is heated before cooling governs its hardness and resistance to breakage. In testing hardness of steel samples, it is found that steel cooled at "white heat" is very brittle and will require a relatively small amount of pressure for breakage. This is due to the coarse molecular structure formed on cooling. Steel cooled at "bright red" heat is somewhat less brittle due to a corresponding finer structure and will require somewhat more pressure for breakage. Steel cooled at "dull red" heat is even less brittle due to the formation of a fine, smooth molecular structure and considerably more pressure is required for breakage. This theory can be demonstrated by observing representative fractures with an ordinary loupe.

Demonstration

Heat the end of a 1/8" steel rod to "white heat" and quickly cool it in water. Clamp it in a bench vise and put enough pressure on it to break it. It will break with little pressure and the fracture will show an irregular surface.

Heat a similar rod to "bright red" and cool it. This one will require somewhat more pressure to break it, and the fracture will show a cleaner break.

Now heat the end of a rod to "dull red" and cool it. This sample will require considerably more pressure to break it, and the fracture will show a clean, smooth surface.

Steel that has been heated for hardening then cooled by submerging it in water is hard and brittle. The same steel cooled by dunking it in oil tends to be somewhat less brittle. Specific oils,

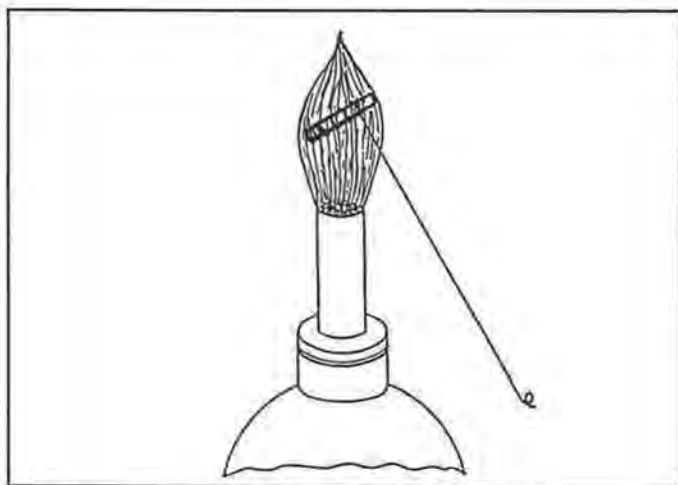


Figure A.

formulated for this purpose, with a safe flash point, must be used to avoid a possible fire or explosion.

A propane torch, alcohol lamp, or Bunsen burner is commonly used for heating. The piece to be heated can be held with pliers, forceps, tweezers, or placed on an asbestos free heating block until it is heated to "dull red," then dropped into water or oil to quickly cool it. To prevent the oxidizing effect of heat and air from forming a hard scale on the surface of the part, heat it slightly at first, then dip it into liquid soap or roll it on a bar of common laundry soap until it is fully covered. This coating will flake off when the part is heated to "dull red" and dropped into water or oil.

To prevent uneven contraction and warping, the item must be quickly dunked or dropped into the cooling medium.

A method commonly used for a part that is thin, or smaller in diameter in the center than at the ends, is to wrap a short length of fine iron wire around it to hold it in a flame, as shown in Figure A. It is heated to a "dull red" and then suddenly cooled. This approach permits cooling by placing the piece endwise into the cooling liquid. When this shape of part is cooled broadside, it tends to warp due to the unequal contraction of metal on opposite sides.

For practice, harden several 3/4" lengths of 1/8" steel rod and several pieces of sheet steel about 1/4" x 3/4" x 1/32" in dimension, using methods described above.

Testing for Hardness

To test steel for hardness, the "file test" is the simplest procedure. A file is drawn over the surface. If it slides over the face

without making a scratch, the piece can be considered hard. If scratches occur, the part is soft and will have to be rehardened.

Tempering Steel

Hardened steel is much too brittle for clock parts, but hardness can be reduced by a process called "tempering." Heating steel after hardening reduces its hardness somewhat, and makes it less brittle and more elastic. When heated to about 580 degrees F. it reaches its maximum elasticity. Color changes observed during heating are used to determine the specific end-point for desired properties to be developed when cooled by dunking. Refer to Table 2 for color/temperature relationships used in tempering steel.

Air Tempering

Air tempering is the most common method used for tempering small parts. In this technique, emery cloth is used to polish the surface of the hardened steel so that color changes that occur during the process can be observed. The piece to be tempered is heated with a direct flame until it assumes the color indicating the temper desired. It is then immediately dropped into water to cool it.

When a piece of brightened steel is heated, the surface will first take on a "pale yellow" or "straw color." This color is formed by the oxidizing effect of the heat and air. It appears when the metal reaches a temperature of about 420 degrees F. At this temperature, brittleness of the metal reduces enough so that cutting

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**Trade-Ins
Taken**

tools will hold their edges, and enough elasticity is added to prevent them from breaking too easily. This temper color is used for drills and taps.

If heating is continued, the color will change to "dark straw" and then "brown." The latter color indicates a temperature of at least 500 degrees F. and has little practical use. Steel tempered to "brown" is too soft for cutting tools and too hard for parts that are to be shaped with cutters. The "brown" color changes to varying shades of "purple" at about 530 degrees F. This color is used only for the sake of color itself, such as on clock hands or screw heads.

The heated steel changes from "purple" to "dark blue," then to a "light blue" at about 580 degrees F. Steel tempered to this color is soft enough to be machined, yet hard enough to withstand wear. This is the temper most commonly used for balance staffs and flat steel parts of a clock.

With continued heating, the color will change rapidly to "pale blue," the temper used for many kinds of springs. Springs tempered to "blue" will usually break under use, but a temper of "pale blue" provides sufficient toughness while retaining the hardness required. After "pale blue," steel changes color to "pale gray," at which point it is quite soft and the temper is said to be completely "drawn."

Color does not always indicate temper. Any piece of steel or soft iron will show the same colors when heated. Colors are useful only in tempering tool steel that has been previously hardened to glass hard, and for coloring clock hands, screw heads, etc.

An exercise using the most common temper colors follows:

1. Harden several 3/4" lengths of 1/8" rod and temper them to "pale straw."
2. Harden several more and temper them to a "dark blue."
3. Harden several pieces of 1/4" x 3/4" x 1/32" sheet steel and temper them to "blue."
4. Harden several more sheets and temper them to a "light" or "pale blue."

Bluing Steel

Steel screws and small parts to be blued (or tempered) can be placed on a bluing slip which is designed to hold the pieces and insure that they are heated evenly to achieve a uniform color. The slip is held over a flame until the color indicating the temper desired appears; then, the piece is immersed in water.

A bluing slip can be made from a piece of sheet brass about 1" x 2" x 1/32". An iron handle about four inches in length is riveted to the brass slip. Several holes for different size screws should be drilled close to the end of the slip and a groove should be filed across it to hold round parts. See Figure B.

When heating for the purpose of bluing screws or other parts, it is important to clean and polish the surface before heating. Care should be taken not to touch the polished surface with fingers. A finger print will defile a color. The finer and brighter the polish before tempering, the better and more even the color will be.

Annealing Steel

Hard steel must be annealed for shaping or machining. This technique removes all the hardness. It is accomplished by heating

the piece to above its "critical range," ("cherry red") and allowing it to cool very slowly. The cooling process can be done in air or in an annealing pan filled with sand, pumice stone, or another suitable medium. An annealing pan permits limited control of the cooling process. Steel can be made even softer by heating it in sand, then allowing it to cool while remaining in the sand, which will take considerably more time.

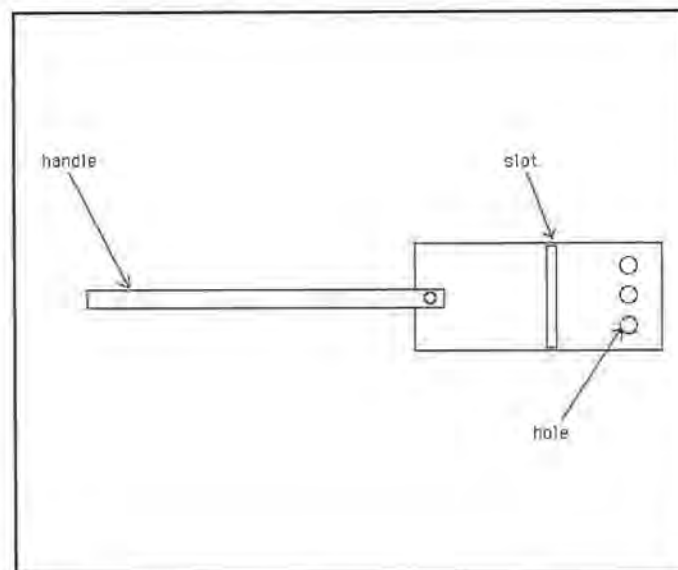


Figure B.

Table 1 Color - Temperature Relationships used in Hardening Steel

Color	Temperature (degrees F.)
Dull Red	1280
Dark Cherry Red	1470
Cherry Red	1650
Clear Cherry Red	1830
Deep Orange	2010
Clear Orange	2190
White	2370
Bright White	2550

Table 2 Color - Temperature Relationships used in Tempering Steel

Color	Temperature (degrees F.)	Use
Pale Straw	430	Gravers, Tool Bits
Straw	450	
Dark Straw	490	Taps
Brown-Yellow	500	
Yellow-Purple	520	Staffs, Screws
Light Purple	530	
Dark Purple	550	
Dark Blue	570	
Pale Blue	590	Steel for Turning
Paler Blue	610	

ASSOCIATION NEWS

INDIANA

The Indianapolis Horological Association held their January meeting at the Heritage House in Indianapolis, IN. Gary Beckman presented the program "Tricks of the Trade." Mr. Beckman is the only diamond cutter in the state of Indiana. He shared many bits of helpful information and trade secrets that were once kept private. The program was geared mainly toward jewelry with some watch and clock repair information being covered also.

MINNESOTA

The Minnesota Clockmakers Guild held their January meeting at St. Paul Technical College. Kern Schwartz, incoming president, recognized Mike Mishou for his leadership as president for the past year. Brent Glommen referenced a variety of historical products and methods used for cleaning movements. John Sullivan presented his experiences with the use of a tumbler for cleaning movements and clock parts.

"Is the Mainspring Set?" was the topic of discussion at the February meeting of the Minnesota Clockmakers Guild. Bill Weast presented the program which covered how to measure the torque created by a mainspring, and data collected by comparing old mainsprings to new mainsprings.

NEW JERSEY

The Watchmakers Association of New Jersey's (WANJ) February meeting featured Tom Park, Chief Product

Engineer for Wittnauer Watch Co. This program was canceled twice before due to bad weather. Mr. Park discussed Wittnauer's new products, including the twenty-year-battery-life watch. He also shared bench tips, service procedures, and information on ordering replacement parts.

A mail-in ballot election was held this year because bad weather prohibited the normal November election. The following officers will serve the WANJ for the remainder of 1996: John Sokol, president; Joseph Cerullo, vice president; Michael Wilken, secretary; and Hans Weber, treasurer.

NEW YORK

At the November 1995 meeting of the Horological Society of New York, Daniel Mied, a well-known horologist and teacher, gave an interesting illustrated lecture on various types of escapements of past horological movements. Mr. Mied also discussed measuring devices for determining the accuracy of positions for pallet stones. Members of the audience experienced hands-on participation with the movements provided by Mied. A lively question and answer session wrapped up the evening.

NORTH CAROLINA

The North Carolina Watchmakers Association has announced the dates for their upcoming annual business meeting. It will be held May 31, June 1&2, 1996 at the Holiday Inn Woodlawn, Charlotte, NC. For detailed information, please contact Alice Carpenter at (919) 823-2944.

OHIO

Elmer Hilvers, longtime Watchmakers/Clockmakers Association of Ohio (WAO) member, passed away on October 7, 1995.

Mr. Hilvers, prior to retiring, owned and operated Hilvers Jewelers in Leipsic, Ohio, which he opened in March 1947. He was a graduate of the Kansas City School of Watchmaking and a member of the WAO for more than thirty years. Mr. Hilvers was a strong supporter for the WAO; he served on the Board of Directors for many years and as Vice President and Treasurer.

He was married to Eva Rose Roesner who survives. Also surviving are his three daughters: Dixie Lee, Peggi Ann, and Rose Marie; one son, Larry; and eleven grandchildren.

WASHINGTON

On January 8, 1996, the Washington State Watchmakers Association held their meeting at North Seattle Community College. Before the regular business meeting, Jeff Griefff gave a lecture on Rolex watches. The subjects covered were: proper oils and greases and their uses, how to achieve difficult procedures, technique for putting on the sapphire crystal, and which watches to avoid servicing due to parts that are no longer available.

President Dean Hinkson presided over the regular business meeting. The discussion included: costs involved in making monthly mailings, sending a delegate to AWI's annual meetings in June, various money-making projects, and the successful schedule of AWI Bench Courses in the Seattle area. ☛

REPAIRING MECHANICAL WATCHES & CLOCKS

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REPLACING REGULATOR PINS,
UNIT II, PART 1

By Henry B. Fried,
CMW, CMC, FAWI, FBHI, ★FNAWCC
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“A regulator with a broken pin may cause a loss of up to twenty minutes a day. Bent, worn, or burred pins also cause inconsistencies in timekeeping.”

One of the most frequent causes of poor timing in watches may be directly traced to the poor condition of the regulator pins. A regulator with a broken pin may cause a loss of up to twenty minutes a day. Bent, worn, or burred pins also cause inconsistencies in timekeeping. Although some new watches are appearing without regulators, these are in the extreme minority so that a knowledge of replacing these pins is still an essential part of the watchmaker's skill and trade.

Replacing a regulator pin may become necessary because of breakage or because it may have become marred, irreparably bent, or kinked (see Figure 1). Bent regulator pins cause the hairspring to waver so that the vibrations are irregular.

To remove a broken regulator pin, the regulator is removed from the balance bridge and the regulator is placed topside-down on a steel bench block. With a sharp well-fitting screwdriver, twist the regulator key completely around so that it appears as shown in Figure 2. Then adjust the regulator so that the stump of the broken pin is directly over a suitably sized hole in the steel block. A sharpened steel needle, set into an appropriate holder, is then placed on the stump of the broken pin and downward pressure is applied (see Figure 3). Sometimes the original pin is lodged rather securely in its hole in the regulator, and some force may be necessary to dislodge it.

Regulator pins can be bought, but sometimes few of these will fit a particular regulator owing to the great variance of these holes. Therefore, it is important to know how to make a regulator pin, should the occasion arise.

To an apprentice, making a new regulator pin is not as simple as it seems. It is not enough to insert a tapered pin to fill up the hole. Regulator pins should present a cylindrical and perpendicular appearance. A tapered surface will cause a slight shimmying of the hairspring. Figure 4 shows how only the bottom edge of the hairspring touches a tapered surface (pin). Here the bottom edge of the spring touches the slanted surface of the outside pin and as it continues to press against this pin, the incidence of these angles forces the spring upward. When the spring expands and is forced against the other surface if it is tapered, the opposite effect will take place, thus the hairspring will have an alternately upward and downward shimmying, all owing to improperly shaped pins.

In order for the pin to become secure in the regulator, the section of the pin that will remain in the pinhole should be slightly tapered, but the part of the pin regulating the hairspring should be cylindrical as shown in Figure 5.

Too thick a pin does not leave sufficient space for the hairspring and a slight amount of necessary freedom. This is shown in Figure 6. If the spring is tight between the pin and the regulator key, any movement of the regulator to bring the balance to time will bend the hairspring as shown in Figure 7.

Regulator pins may be made from hardened brass, nickel, or wire. Straight brass pins are ideally suited for conversion because these are hardened and are of sufficient thickness to permit handling and reduction in diameter without too much waste. The first operation is tapering the wire until it enters the pinhole in the regulator and extends through it as shown in Figure 8. Tapering

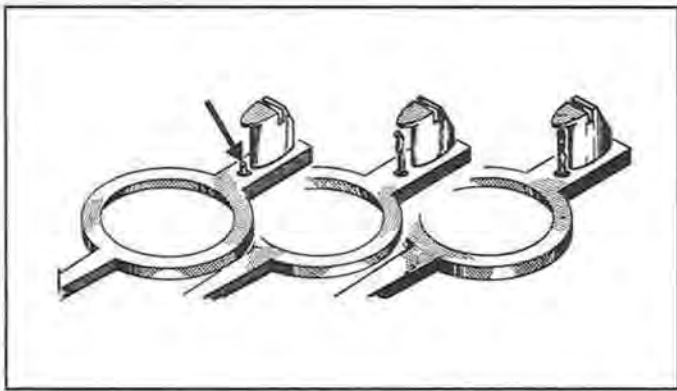


Figure 1. Broken, bent, or marred pins must be replaced.

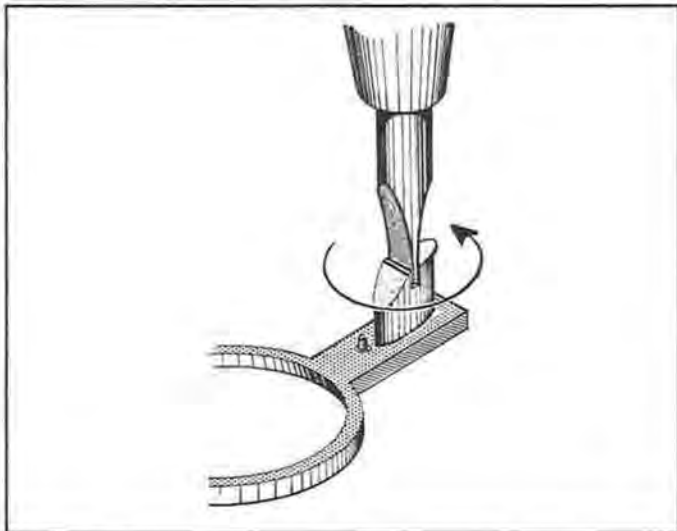


Figure 2. First step in removing the pin is to twist regulator key completely around with a sharp, well-fitting screwdriver.

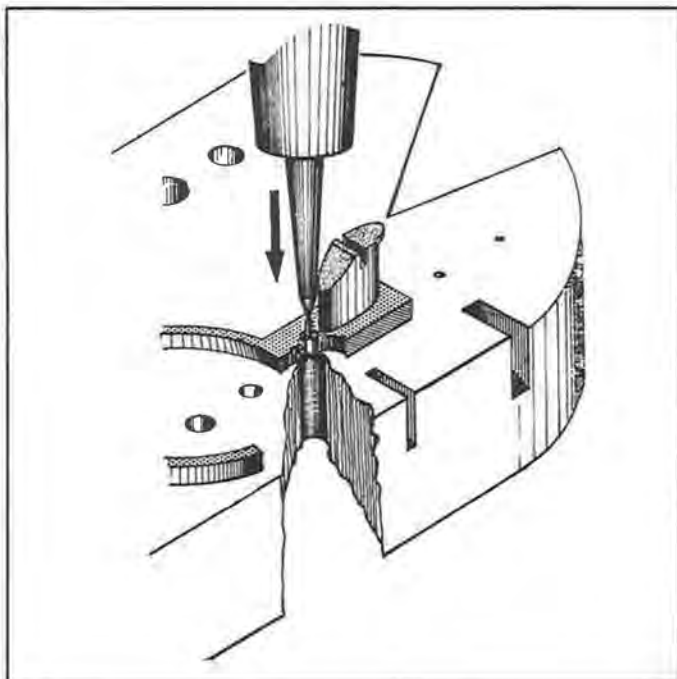


Figure 3. Regulator pin is dislodged with a sharpened needle and pin over a hole in a block.

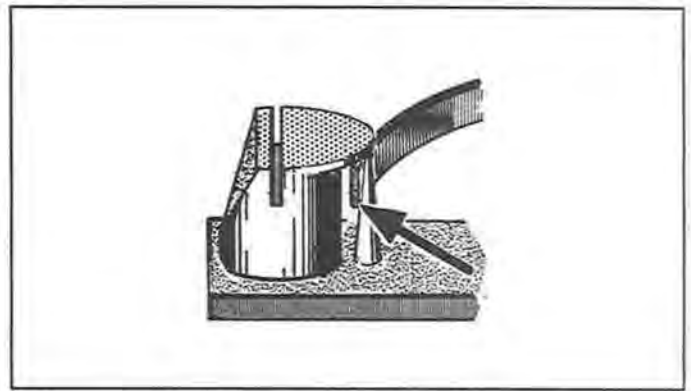


Figure 4. A tapered pin will cause a slight shimmying of the hairspring as only the bottom edge of spring touches regulator pin.

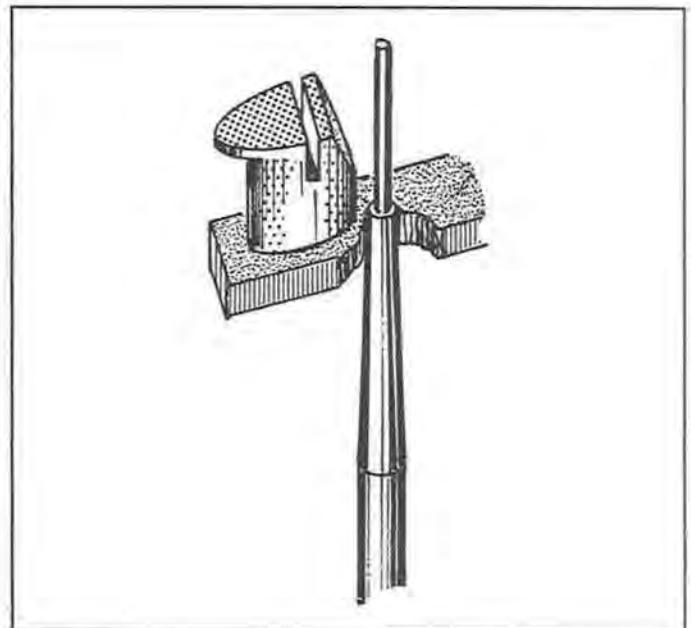


Figure 5. Only bottom part of the pin to remain in pinhole should be tapered to securely fasten it.

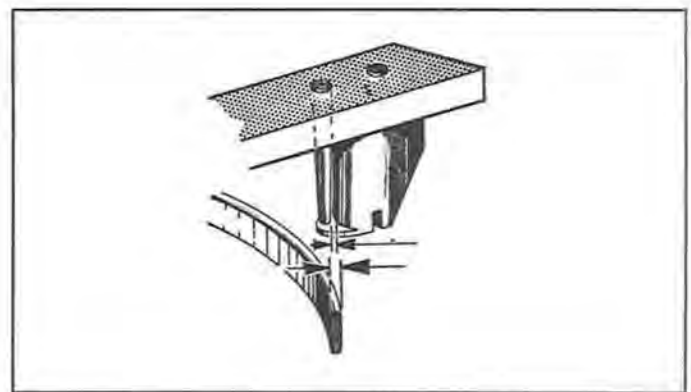


Figure 6. Too thick a pin does not allow the space necessary for freedom of the hairspring.

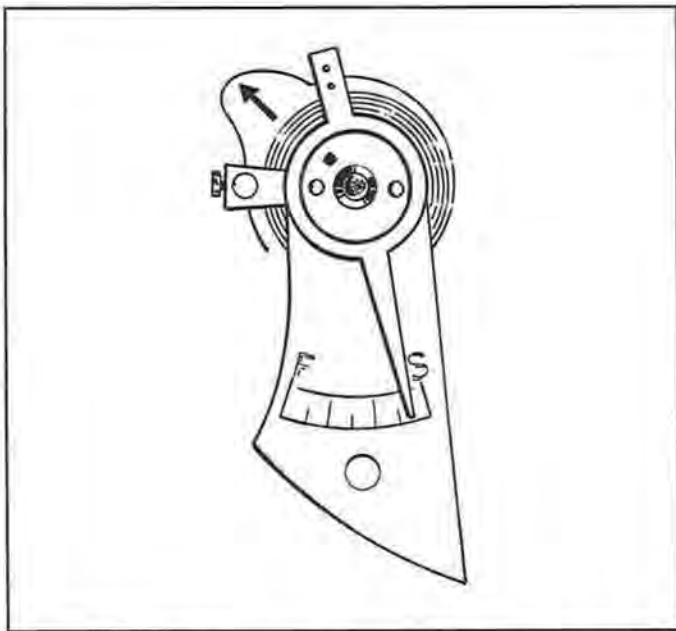


Figure 7. Too little space between the pin and regulator key will bend the hairspring when the regulator is moved.

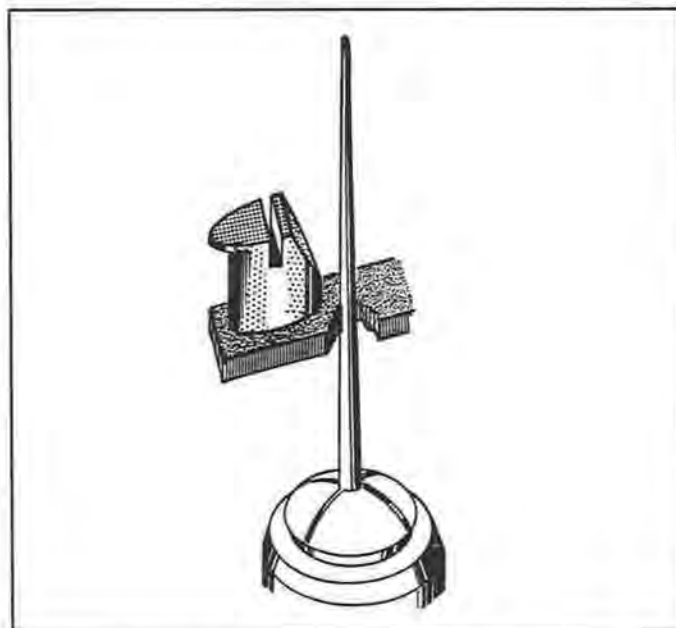


Figure 8. First operation in making the pin is tapering it until it enters the pinhole as shown.

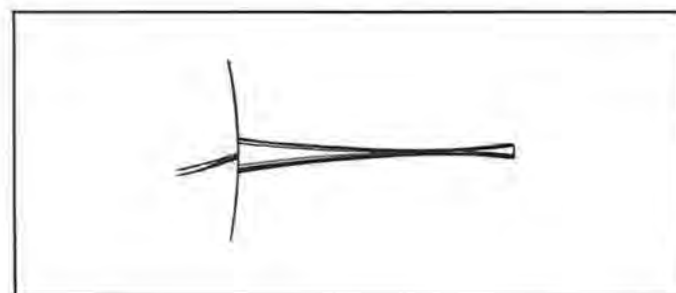


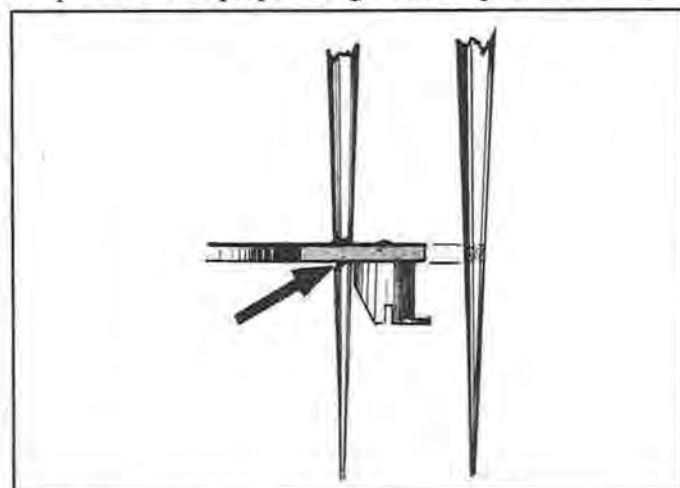
Figure 9. Too much pressure against pin with the file while turning in the lathe will cause result as shown.

the pin can be done in the lathe or in the pin vise, skillfully manipulated. When made by hand, the brass taper pin is held in the pin vise and the pin is rested in a shallow groove of a wooden block held in the bench vise.

Ready-made taper pins are about 1/4" (6.35 mm) long. These have a taper that gauges about .60 mm at one end (thick end) and tapers down to about .25 mm at the other (thin end). This insures a taper of the correct angle—one that will easily be secured and not work loose.

When the pin is made in the lathe, a fine flat file could be used to bring the taper to shape. The file is held underneath the wire so that the work may be seen. In this case, the direction in which the lathe generally turns must be reversed so that the file can cut. Care must be exercised not to press too hard up against the taper as this will bend it and make it appear as shown in Figure 9. Some watchmakers prefer to use a Jacot runner or a steel block with groove to support the pin while the taper is being formed. In such a case the file is run across the top of the pin instead of under it.

After the first taper is formed, the regulator is fitted over the taper as shown in Figure 10 and pushed as far as it will go, twisting it on with a little pressure. Then the regulator is twisted off again. The place on the taper pin that was tightest in the regulator pinhole will show a burnish mark (see Figure 11). This point is noted because from that mark outward the pin must be reduced in thickness so that it becomes cylindrical, or a file mark is made at the spot where the taper pin emerges from the pinhole in the regu-



Figures 10 and 11. The regulator is twisted on taper as tight as possible. This spot will be indicated by burnish mark and from this point onward, the pin is made cylindrical.

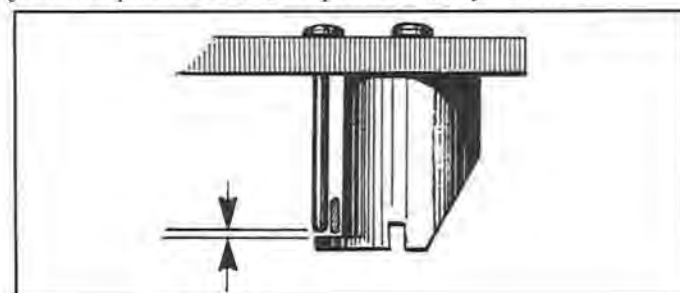


Figure 12. Before tapered pin is converted to cylindrical shape it must be cut to proper length.

lator (shown by the arrow in Figure 10). This too will indicate where the tapered section of the pin is to be converted to a cylindrical shape.

Before this operation is started, this section is shortened to its proper length. The length of a regulator pin must be adjusted so that it will permit the toe of the regulator key to be closed under it (see Figure 12). It should not be too short so that the hairspring can escape from it (see Figure 13). The length of the regulator pin is adjusted at this time because it is still thick enough to have its end filed flat, which could not be done if it were thin. Furthermore, if it were left longer it would be difficult to make it cylindrical and as thin as required.

To determine the correct length, the regulator key is turned partially back again, and the pin is cut off flush with the bottom surface of the key. Then, the file works across the front tip of the pin until it is about .05 mm above the top of the toe of the key, leaving this much freedom between the top of the toe of the key and the end of the pin.

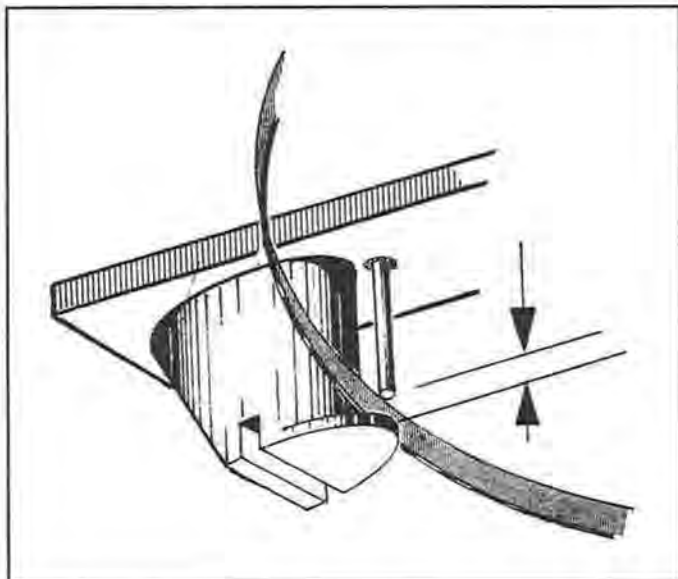


Figure 13. Regulator pin must not be cut off too short so as to allow the hairspring to escape from under it.

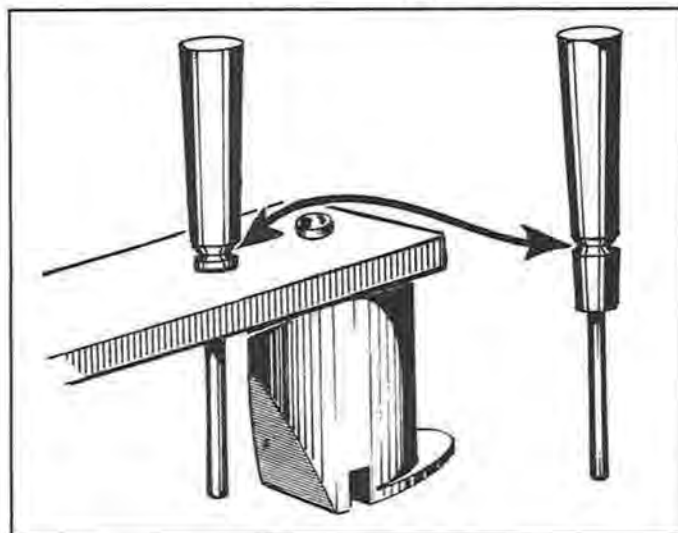


Figure 14. Groove is cut into section of the taper just above the point where it enters hole to facilitate breaking off this portion.

The cylindrical portion of the regulator pin when finished, should gauge about .10 mm. However, the filing should be stopped when the pin reaches .15 mm. Here, a burnisher or a fine jasper stone is used to finish the pin so that when it is reduced to its final thickness it will have a fine finish and be free from file marks. When this is done, it should look like Figure 14. To facilitate breaking the pin after it is turned to dimensions, a groove is cut into the section of the taper which is just above the point where it enters the pinhole in the regulator, shown by the arrow in Figure 14.

After this operation, the regulator is twisted on the pin as tight as it will go. A slight bending twist will break the pin at the groove (see arrow—Figure 14). The top of the pin is then finished off with a file, burnisher or jasper stone, taking care not to scratch the polished steel top of the regulator. The finished job should look like Figure 15.

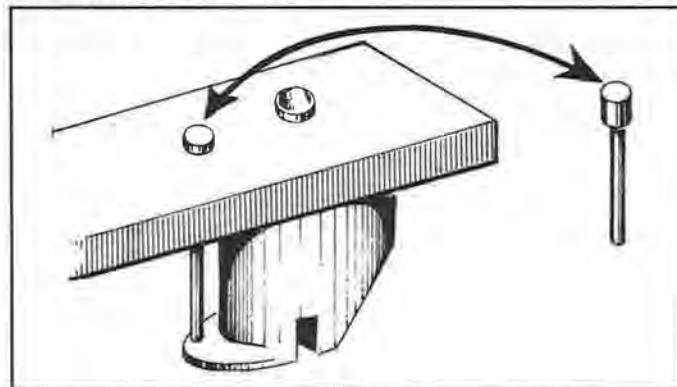


Figure 15. After breaking off unwanted portion above the groove, top of pin is finished off with file, burnisher, or jasper stone.

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INDUSTRY NEWS

World Watch, Clock and Jewelry Show: April 18-25, 1996

The Swiss exhibitors at the World Watch, Clock and Jewelry Show are the ambassadors of a dynamic industry ready to confront the challenges posed by the globalization and evolution of its markets. Faced with moderate figures for 1995, it is reacting with lucidity, coherence, a capacity for innovation, and a commitment to quality at every level.

Mixed Results

The high value of the franc, the saturation of traditional markets, and changing consumer behavior are just some of the problems confronting the Swiss watch industry. Nineteen ninety-five's global export figures, though still incomplete, will probably show a slight drop compared to the previous year's record-breaking results. A breakdown by material reveals increased sales in watches made of silver, stainless steel, and other metals like brass and aluminum at the expense of gold, platinum, and stainless steel/gold on the one hand and plastic on the other. However, compared

to Swiss exports as a whole over the last ten years with a global export increase of around 50%, the watch industry has enjoyed well-above-average results, almost doubling in turnover. These impressive figures should not be unduly affected by the 1995 results and should remain above 8% per annum. The industry has every reason to be optimistic.

Prospects for New Markets

The prospects for new markets in Asia, Eastern Europe, and Latin America look interesting despite the fact that high labor costs in Switzerland and political instability in certain importing countries paint a somewhat less rosy picture. The Swiss watch industry should also benefit from the partial easing of trade restrictions in India, a market with enormous potential where Swiss watches are highly valued.

Dynamic Industry

At the same time, watchmakers are going to great lengths to adapt to new consumer behavior. Innovation and creativity have been put high on their agenda along with investment in the research and development of new prod-

ucts and technologies. Positive initiatives include the launching of new companies and the development of new production methods for manufacturing low-priced watches. Companies are also strengthening their brand identity and demonstrating greater coherence in defining their collections and communication strategies. To improve their image, some exhibitors at the World Watch, Clock and Jewelry Show have even invested in new stands, just three years before the show undergoes the complete restructuring outlined in the Messe Basel Plus project.

Excellence of Products

Manufacturers remain deeply committed to the image of quality and exclusiveness for which their products have become internationally renowned. The jewelry, classic and sports watches presented here are stunning examples of Swiss creativity at its most consummate and refined. Luxury jewelry timepieces, the concrete expression of women's dreams, are in strong evidence and there is a clear trend towards art deco, while Mickey Mouse brings a refreshing element

of humor to the industry's most sophisticated creations.

Featured this month are three watches that can be seen at the 1996 show.



Figure 1. PATEK PHILIPPE - A technical tour de force, the 18K gold wristwatch chronograph is a masterpiece of precision and reliability. The originality of its complicated movement lies in the combination of a split-seconds chronograph with a thirty-minute counter, a perpetual calendar and moon phases, a small seconds hand and a day, date, month, and leap-year indicator, all housed within an elegant case. With the fly-back function, events of varying lengths can be timed simultaneously. The dial, in silvered opaline, is embellished with 18K yellow-gold Arabic numerals and hands. A sapphire glass case back reveals the magnificent work on the movement.



Figure 2. **BREGUET** - At the end of the eighteenth century, Abraham-Louis Breguet, the celebrated watchmaker and founder of Breguet, conceived and invented the tourbillon regulator to overcome the time variations caused by the positional errors which plagued early pocket watches. His invention has now been given a new dimension through the transparency and refinement of the 18K yellow-gold skeleton watch with a tourbillon movement. The hand-winding movement with a Breguet balance spring is hand-engraved and features a perpetual calendar giving the day of the week, month, and leap year. The small seconds hand is placed on the tourbillon axis and a serpentine hand indicates the date. The silvered gold chapter-ring and auxiliary dials are hand-guilloché.



Figure 3. **GIRARD-PERREGAUX** - This stunning wristwatch, fashioned in platinum, is the culmination of hundreds of hours of exacting and meticulous work and an extraordinarily high level of precision. Featuring a tourbillon mechanism, it represents

yet another tour de force from the master watchmakers of the Manufacture Girard-Perregaux. The structure of the bridges is enhanced by the hand-winding skeleton movement, which is in yellow, pink, or white gold. The bezel and its attachments, as well as the hour markers, are luxuriously set with diamonds. A true work of art inspired by the past and brought to life by the skills of modern master watchmakers.

Vibrograf U.S.A. Corp. Introduces the Vibrograf Check Impulse

Mr. Joseph Presti, President of Vibrograf U.S.A. Corp., announced the introduction of an amazing new quartz watch repair tool. The Check Impulse tests the electronic circuit and will restart many previously nonrepairable watches by magnetic energy. It also can be used to improve lubrication and set hands. At only \$239, it is a must for every watchmaker's bench.

For further information contact: Mr. Joseph D. Presti, President, Vibrograf U.S.A. Corp., 504 Cherry Lane, Floral Park, NY 11001-1696. Phone: (516) 437-8700. Fax: (516) 437-8708.



Figure 4.

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Casio Introduces Two New Watches

Two watches, a "touch icon" Databank and "analog/digital" Twincept, were displayed by Dover, New Jersey-based Casio, Inc. at the Consumer Electronics Show held in Las Vegas in January.

VDB-200 Databank, \$119.95 suggested retail, will be available in June, 1996. The touch of an icon on the watch dial activates the features that include 200 pages of Telememo and 200 pages of Schedule-memo. Both the Telememo and Schedule-memo feature an automatic name-sorting function. (Memories are shared between Telememo and Schedule-memo.)

The watch also features a multifunction alarm, hourly time signals, count-down alarm, and a 1/100 of a second stopwatch.

The VDB-200 features the regular time-keeping functions of hour, minute, second, am/pm, month, date and day, has an auto-calendar that is preprogrammed until the year 2039 and can reveal the time in either the 12-hour or 24-hour format. It has an electro-luminescent backlight so that you can see the time in total darkness.

A B X 6 0 B - 7 A , Twincept, \$199.95 suggested retail, will be available in May, 1996. "With a Twincept analog/digital combination watch, you can go from fashionable to knowledgeable at the push of a button. It's a watch that works twice as hard," said Marty Gormley, Vice President of Casio's Timepiece

Division.

"Keeping track of your contacts is as easy as keeping time with the Twincept," says Gormley. "As a watch, the Twincept is an attractive analog watch, but as needed, you can activate the LCD 'screen' to access its impressive digital features which include fifty pages of Telememo, 1/100 of a second stopwatch, five multi-function alarms and world-timer."

The ABX60B-7A is water resistant to fifty meters and has an electro-luminescent backlight so that you can see the time in total darkness.



Figure 5A. With Casio's ABX60B-7A "Twincept" analog/digital combination watch, you can go from fashionable to knowledgeable at the push of a button.



Figure 5B. Casio's VDB-200 Databank is pictured. The touch of an icon on the watch activates features that include Telememo and Schedule-memo functions.

Polish Intricately Detailed Jewelry in Minutes

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not work-harden the surface, making stone setting easy. This compact, virtually silent machine can polish an average of 25 ladies rings every 30 minutes polishing 200 rings in an 8-hour work day. Powerful magnets inside the tumbler base cause miniature steel shot media to spin around the jewelry. By constantly changing the polarity, the spinning shot reaches those areas once impossible to polish.

Call Gesswein and make arrangements to send samples to polish. They will be returned with a detailed report on how they were finished. This service is free of charge. For more information contact RoseMary Massage at Paul H. Gesswein, Inc., 255 Hancock Ave., Bridgeport, CT 06605. Phone: 1(800) 544-2043, extension 241.



Figure 6.

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AFFILIATE CHAPTER COLUMN

By Jack Kurdzionak

No Free Lunch But Still A Good Value

I was recently given four large cardboard boxes of old periodicals, some of which dated back to the early 1950s. Included in this collection were old copies of the Horological Institute of America's journal which is a predecessor to our *Horological Times*. There were announcements every month for the meetings of various state horological associations. In those days, the state associations had speakers from all of the major American watch and clock companies as well as Swiss watch companies at their meetings. The manufacturers also presented educational workshops for horologists who wanted to keep abreast of the changes in the industry. There were no costs associated with these meetings and workshops because the manufacturers paid the expenses associated with the programs they presented. The state dues for this period averaged about \$5 per year and the Horological Institute of America's dues were about \$10 per year.

When I joined the Massachusetts Watchmakers Association twenty-five years ago, things had already begun to change. Manufacturers were still presenting programs to our members, but our program chairman had to work harder to attract the speakers. Dues in the association began to rise and membership dwindled.

Today, industry programs are almost nonexistent and program chairmen are challenged to present a good program at every meeting. What are we to do? If we don't bring something of value to our meetings, members will not attend. If members don't attend, they will not continue their membership in the association. We must now face the reality that it costs something to present a good program and the membership must share those costs. In the so-called good old days, the manufactur-

ers felt that the investment they made in programs for chapter meetings would pay dividends to them by increasing the sale of repair materials and decreasing complaints about service in the field. Apparently, most of today's manufacturers and importers do not see any value in that kind of an investment. We cannot look in this direction for programs.

Our program chairmen must now seek out people in our industry who are willing to donate their time and expertise to a chapter meeting, and I can assure you those people are out there. What we cannot expect is to have these same people donate their time and expertise, and also pay their own expenses to travel to a meeting. The affiliate chapter is going to have to provide funds from its own treasury to bring qualified speakers to its meetings. You might say to me that the local treasury is so low in funds that a round trip airline ticket is out of the question. An alternative to this is to have each member who attends one of these special meetings pay a small sum to offset the travel costs of the speaker.

I spoke recently to AWI member Mark Butterworth of Muscatine, Iowa. In addition to operating a clock repair shop, Mark is a distributor for Urgos clock movements as well as a dealer for Hermle clock movements. He has prepared a clock repair workshop that he would be willing to share with any affiliate chapter in the country. To keep the airline fare low, he will travel on a weekend and present his program at a Sunday meeting. All he needs is an airline ticket and accommodations for a Saturday night stay. It seems to me that if a member of a chapter had to pay a small fee to attend Mark's workshop, it would be a good value for the money spent.

The days of the free lunch are over. We horologists must take responsibility for

ourselves because no one else is going to do it for us. When all things are considered, there is no free lunch anywhere. Whatever you do has a cost in money, time, or both. The most important consideration in spending your time or your money is if you are getting a good value for what you have spent. Today even television viewing is expensive. Many of us pay to have cable TV, in addition some have pay per view, and we all pay in time spent to watch the TV. You must decide whether TV viewing is a good value for the time and money spent. I can assure you that your attendance at a workshop for clock or watch repair is going to be an exceptional value.

The horological professions are special in that most of the practitioners truly enjoy their work. It is one of those occupations that demands a deep commitment from the people who have chosen it as a vocation or an avocation. In plain English, this profession is one that you either love or leave. With this in mind, I urge you to examine the possibilities of funding the travel expenses of people who are willing to donate their time to your chapter. These people are willing to give freely of their time and talent because of their love of the profession. All we must do is meet them halfway and provide for their expenses for the visit. The time and money spent for professional development is truly a good value when weighed against some of the other things we spend our time and money doing.

If you need some suggestions for speakers and programs, give me a call at (617) 438-6977 or write to me at AWI. Mark Butterworth is just one of a number of people who are more than willing to give of themselves. Seize the opportunity to bring these people to your meetings. ☛

BULLETIN

BOARD

A. NEW REQUESTS

Clock Strikes At Rapid Speed

Jordan Renaud, Deep River, Ontario, Canada, has an antique Beehive-type clock with lyre plates, circa 1860-1870. This clock has eight wheels in the strike train including the fly. The third wheel in the strike contains the pin that activates the hammer tail. Even though the fly is attached tightly to the arbor, the strike sequence occurs very rapidly. The clock has the original power springs in it. Can anyone suggest the reason, and a remedy for this rapid striking problem?

"Regina" Music Box

Cameron Spicknall, Elmira, NY, is seeking the phone and/or address of the distributor of "Regina" music boxes. We have directory listings for firms using the name "Regina;" they are located in Schwenningen and Porzheim, Germany and Les Genevez, Switzerland. They are basically watch/clock manufacturers and there is no indication which, if any, produces music boxes. Can anyone help with a distributor in this country, or manufacturer in Europe?

Expansion Band Repairs

In mid-1995 we were advised of a firm which did

an excellent job repairing expansion bands. After we published the firm's name and address we were advised that the individual had recently died. Now we are back to square one. Roger Hunt, Ocala, Florida, is the latest to request a source for such repairs.

Sharp Talking Clock

Gary Block, Agawam, MA, seeks the address/phone number of the firm which distributes Sharp Corporation Clocks by Bentley Inc. out of Los Angeles, California. These are talking clocks. We have a listing for the Sharp Talking Clock in Japan; it is Sharp Corp., 22-22 Nagaike-Cho, Abeno-Ku, Osaka, Japan. Can any reader supply a contact for this clock in the United States?

B. RESPONSES

IBM Radio Time Longcase Electrically Wound Clock

George Bacon, G.B. Technologies, an AWI member in Toronto, Canada has also supplied the IBM Manual for their Type 37 Radio-Supervised Clock requested by V. Rodriguez.

In addition Mr. Bacon has supplied an IBM Time Equipment Systems Manual for the Technical Library.

The manual contains most of the equipment connected with a clock system from the early 25 master units up to and including the 91 series master clocks with 12-hour corrections. Most all the engineering changes and newsletters have been incorporated into this manual's contents. It is a very important addition to our library.

C. ITEMS STILL NEEDED

Waltham Display

George Kuckenbaker, Harpers Ferry, WV, recently received the Waltham display as a gift (see Figure 1). The circu-

lar Lucite contains model 771,681, and 6/0-D, 21-jewel movements all marked 5 adj., made in U.S.A. There are gold hands on all of the movements.

Any information about this display, such as its purpose and approximate date will be appreciated.

Aurora Clock by Kirsch Hamilton

Walter Celli, Nanuet, NY, seeks any information anyone can supply about the Aurora clock by Kirsch Hamilton in Massachusetts. Mr. Celli has tried to contact them by phone with



Figure 1.

no success. A check of the current *Thomas Register* fails to provide an entry for Kirsch Hamilton although AWI files list them without an address.

Trinad Rock Klox

Donn Kummer, Tangent, OR, has a Trinad Rock clock with loose hands. He can get the back off but can't get the dial out of the bezel. It doesn't seem to pry off. The glass crystal, which he is afraid of chipping, may be epoxied. Mr. Kummer hopes to hear from anyone with information about this clock.

Vigor Electric Soldering Machine, Model SM-800

William Carson, Groton, MA, recently purchased a

Vigor Heavy Duty electric soldering machine. He is seeking a user's manual and spare parts list.

Waterbury #100 Hall Clock

Richard Porter, Minneapolis, MN, has frequently helped with "BB" requests. Now he seeks information about a Waterbury #100 pin wheel escapement hall clock movement which he has for restoration. Specifically, Mr. Porter seeks the following information:

- 1) Suspension Spring: Material, length, width, thickness, and is it single or double leaf?
- 2) Cable: Size and material?
- 3) Date of manufacture?
- 4) If possible, a source for

or picture of the sweep second hand that fits the protruding tapered end of the escape wheel arbor.

Pictures or technical information from someone familiar with this clock will be appreciated.

Zenith Wilcometre Manual

E. Kiska, Grosse Pointe Farms, MI, is seeking an instructional manual for the operation of a Zenith Wilcometre watch rate recorder. AWI will be happy to copy yours for Mr. Kiska and return yours to you.

Distributor or Service Center for Peltier Watches

George Stuscavage, Martinez, CA, seeks the name and location of a distributor or

service center in the United States for "Peltier" brand Swiss watches.

Pieper Clock Company

Raymond A. Meffert, Arlington, MN, is seeking the address and telephone number of the firm that markets Pieper Clocks.

Elma Amplifix Balance Amplitude Meter

W.E. Robertshaw, Dunedin, New Zealand, recently acquired an Elma balance amplitude meter made in Singen, Germany. It could easily be 20-30 years old. He is seeking a copy of the service manual or an instruction book for this instrument.

Tools for the Watchmaker



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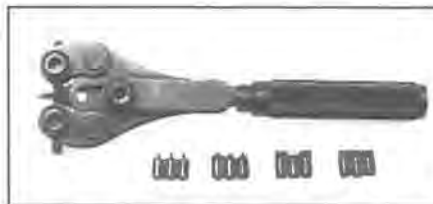
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Continued from page 2.

The library has an excellent collection of periodicals dealing with horology and related subjects. Some are available on loan, or copies can be made of specific articles appearing in a publication.

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The Orville R. Hagans Time Display

The time display is truly a study in time. It includes many devices used through the ages to show the passage of time. The display has such items as a sundial, sand glass, water clock (clepsydra), time candle, and time rope. From these early timekeepers, visitors to the display can go on to view a diverse collection of clocks and watches, ranging from handmade models to the mass-produced quartz timepieces of today.

Other memorabilia, embracing the tools and equipment used by horologists, will give the visitor some idea of the skills and techniques needed by these craftsmen in the pursuit of their worthy profession.

Of particular interest is a Foucault Pendulum which is nearing completion in the circular time display recently assembled at AWI's new headquarters building. This pendulum occupies the center of the time display and is unique in that it will be only the second known installation impulsed from the base rather than from the top suspension.

Thanks to the generosity of AWI members and friends, the collection in the time display has grown and continues to grow. Gifts are tax deductible if made to the ELM Charitable Trust. Because of security restrictions and staffing, it is necessary to make arrangements for your visit to the display in advance. Call AWI Central (513) 367-9800 to arrange a visit. 🐼

Continued from page 20.

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JULY 1996				
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19-22	Lathe Course (Phase I)	Arlington, TX	Roy Hovey	\$280.00
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27-28	400-Day Clock Repair	Oakland, CA	Ron Iverson	\$100.00
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10-14	Accutron Repair	Henry Frystak	\$262.00
23-27	Advanced Quartz Watch Repair	Robert Bishop	\$250.00
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