# Pivots: Part 2

**by Ken Reindel (CO)**

*Editor's Note: This is the second of a two-part series.*

## Technique

The method for restoring soft pivots is fairly simple with minimal practice, once the tools are prepared. Mount the wheel in the lathe as described earlier in Part 1, dress and oil (transmission fluid as a cutting lubricant) the burnisher, and pass the burnisher over the pivot multiple times, using light but firm strokes (Figure 1). Practice applying pressure to the entire length of the pivot. Sometimes it helps to vary pressure along the width of the burnisher, to ensure full coverage, but do NOT rock the burnisher or you may score the pivot. Sometimes it helps to move the burnisher from left to right as you pass the burnisher across the pivot to help avoid developing rings.

Remember you are also flowing and work hardening the surface, which responds better to gradual removal of the tool from the work piece, so do not simply pull up the burnisher from the work. Obviously, you don't want the burnisher to slip off and push into the side of the pivot or arbor.

An indication that the burnisher is working is the appearance of blackening oil where the burnishing was going on (Figure 2).

A great deal of debate ensues about whether to burnish from the bottom of the workpiece or from the top. This is a matter of personal preference. I prefer working from the top, where most of my work is on somewhat larger pivots and support is helpful. But periodically, such as when polishing smaller pivots,

**Figure 1.** Setup for burnishing.

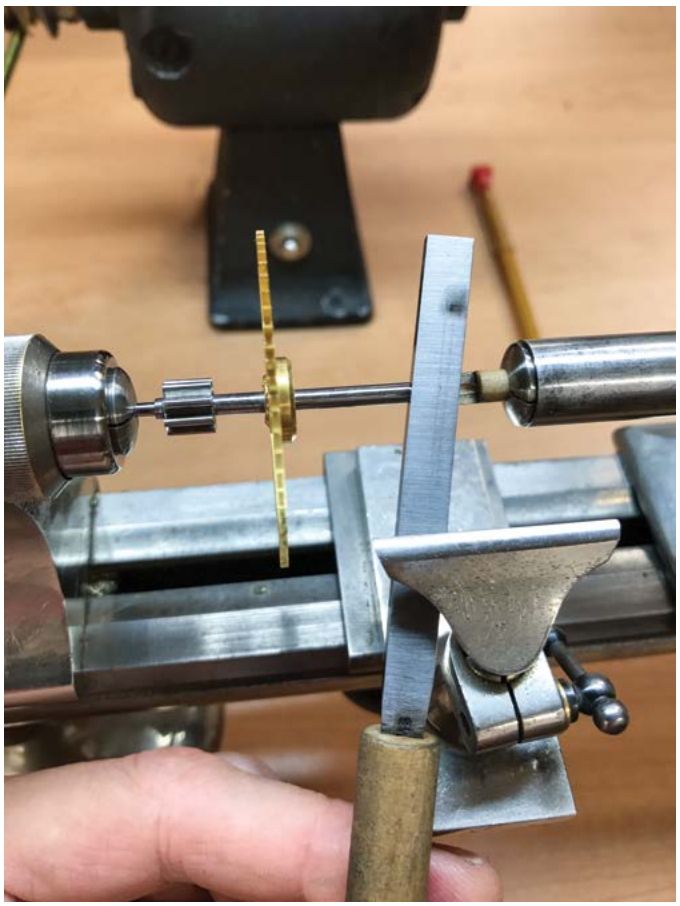

**Figure 2.** Darkening oil indicates that the burnisher is polishing.

I'll switch to the bottom, and then it is easy to observe progress.

With larger pivots, you'll notice that it takes a bit more time to develop a burnish, so be patient. If after a dozen passes with the burnisher you find that the pivot is still dull, or if score marks seem to persist, it may be that it was not adequately prepared prior to burnishing. Perhaps switch back to the Arkansas stone and work out any score marks or blemishes and then return to the burnisher. Sometimes, I'll simply redress the burnisher and try again. If the wear is not severe, the burnisher may eventually work out all of the wear, and the resulting job will be as shown in Figure 3.

**Figure 3.** Polished pivot.

As a reference point, compare this to Figure 4, which is the same pivot after cleaning, but before dressing and polishing. In this case, some wear was dressed away with the Arkansas stone prior to burnishing, leaving the pivot dull gray but with the proper shape and a surface that was easily burnished.

**Figure 4.** Same pivot as in Figure 3 but before dressing and polishing.

If you are filing or stoning, don't forget to apply the cutting fluid or oil and take great care to apply even pressure. You want to end up with a cylinder-shaped pivot, not a cone! Eventually, you will develop an eye for the resulting pivot geometry. If unsure, use a micrometer first by measuring the tip and then just off the shoulder and compare. It will keep you "honest" and help you learn the art of developing a cylinder-shaped pivot. Be careful when checking not to mar the freshly polished pivot! See Figure 5. I think 0.0005" difference between tip and shoulder is borderline for a common .054" diameter pivot, but in most cases would go unnoticed. It should be difficult to distinguish them either by eye or with the micrometer. By contrast, 0.001"–0.002" would be noticeably conical on this pivot.

Sometimes, a roller filing rest is helpful; other times simply resting the burnisher on the lathe's steady rest works just fine. It probably isn't a good idea to file or stone against the steady rest, and here the roller filing rest may come in handy. Just be sure you check to make sure whichever rest you use is parallel to the arbor being worked. For many years I've used the steady rest for burnishing with no ill effects.

If a pivot is conical as found, you must decide what is best. Some argue that it is best left as such, especially on very early handmade clocks from the seventeenth or eighteenth centuries. But on late nineteenth- and twentieth-century factory clocks that were poorly maintained, I prefer to work toward restoring the pivots to the original intention of the manufacturer when possible, which in most cases would have been cylindrical geometry.

## Ultra-hard Pivots

Some early European and high-quality American clocks used hard pivots. These present a bit of a challenge when burnishing, because the pivot material is harder than the standard burnisher (or file)! They will simply skip the hard pivots but will not cut. Here, Arkansas stones will help dress out wear. But what about burnishing?

There are two viable burnishing solutions that I have found work fairly well. For smaller pivots—perhaps under .025" diameter or so—a sapphire burnisher available from Eternal Tools (and others) can work very well. See Part 1 Figure 5, third from the top, on page 424 in the September/October issue of the *Watch & Clock Bulletin*. Dressing a sapphire burnisher requires something with a little more bite than silicon dioxide paper. Although always in search of a better method, I have found that a set of diamond files works very well. The EZE-LAP kit shown in Figure 6,

**Figure 5.** Checking for cylindrical pivot geometry near root; result is then compared to measurement near tip.


**Figure 6.** EZE LAP diamond files.

available from various suppliers, gives us a choice of five grades. For dressing the sapphire burnisher, the fine grade seems to do a great job.

For larger hard pivots, a C-2 grade carbide slip is a very handy solution (available online from Centennial Carbide and others). See Figure 7. This particular slip started its life as a 0.325" wide x 0.110" thick x 5" long carbide slip. However, Centennial's 0.25" wide x 0.125" thick x 6" long size would have perhaps worked better. These slips must be dressed before use; the method is similar to that used for the standard burnisher. However, you will have to spend a good deal of effort the first time you dress this slip because you must "create" the burnisher surface before first-time use. Select the Coarse EZE-Lap grade. Use plenty of oil and take your time; it could take an hour or so to get the surface on both sides right initially. Dressing is the same as described earlier, except the burnisher must be moved up and down against the diamond file. In this case I did not find it necessary to dress the entire length. I find it easier to rest the diamond file on a flat surface and pass the burnisher over it. After the initial rather time-consuming preparation, a few maintenance strokes to re-grain the surface take only a few seconds.

Although rather expensive, it might be worth considering diamond abrasive paper for surfacing the carbide burnisher, available under the name "Kent 5" on Amazon. They are small, 2.25" x 3.5" sheets, but they work. I have recently tried the 120 and 220 grade and experienced very satisfactory results. There are also DMT diamond stones available (again, somewhat expensive). The large stones are on my wish list of things to try in the future, but the EZE-LAP diamond files and "Kent 5" 120 and 220 grade paper provide two viable solutions.

Once the carbide burnisher is prepared, experience will show that it holds up a bit longer after a dressing than the standard (high-speed steel) burnishers available from suppliers. You might even be tempted to switch to the carbide burnisher once it is properly prepared and use it for everything you do. It's worth

**Figure 7.** Carbide burnisher.


**Figure 8.** Cutting the paper strips.

considering. Oh, and the fact that it does not have trapezoidal edges seems to be of no consequence. In fact, perhaps it makes cutting into the shoulder less likely, but you should still "dull" the edges as previously described.

## Cumbersome or Inaccessible Pivots

Given virtually any clock, there are always a few rather inaccessible pivots to deal with. Strike levers and especially escapement arbors are examples. These pivots sometimes wear on only one side or in other odd ways. In any event they must be cleaned up before attempting rebushing. Because of the concentrated wear, the pivot is sometimes too far gone to salvage; then we must evaluate various methods for repivoting these odd-shaped parts—a topic for another article—but for now, let's look at a few ways to resurface a pivot that is still serviceable.

The process involves four distinct steps:

1. Remove wear with 600 Wetordry™

2. Condition pivot with 1,000 Wetordry™

3. Pre-polish with 2,500 Wetordry

4. Polish with Flitz™ or Simichrome™ medium

Again, this only works for pivots with minor wear. If there is major wear, then other methods will need to be sought out, including possibly repivoting.

Start by cutting the paper into thin strips no wider than the length of the pivot to be polished. This width is important! Cut several strips because the method can be a bit harsh on the paper. For this purpose I have found that 3M Imperial Wetordry works well and is flexible enough for the task at hand (Figure 8).

Next, mount the part to be polished in a vise or similar. You will need two hands free, so a vise or some other way to hold the part is absolutely necessary. Starting with a cut strip of 600, hold each end of the Wetordry strip and pass it like a belt around the pivot, working back and forth, all around the pivot, putting a light tension on the paper and keeping it flat

**Figure 9.** Removing wear and pre-polishing inaccessible pivots.

**Figure 10.** Final polishing on inaccessible pivot.

against the pivot, one side at a time before moving to the next. Repeat the process until all wear marks are removed. Then, graduate to the next grade paper, and then to the next until a nice, polished pivot is evident (Figure 9). It takes a bit of practice but in a few minutes you'll be proficient enough to get the job done.

Finally, cut a 1" length of 1/8" birch dowel and mount it in the lathe headstock. Drill a hole the size of the pivot in one end. Smear some Simichrome™ or Flitz™ polish on the drilled end of the dowel and, as it spins in the lathe, gently press the pivot into the hole, being careful with the pivot but firm enough to let the polish do its work. This step is illustrated in Figure 10. As the dowel turns, the now impregnated polish will leave an incredible surface finish on the pivot. It helps greatly to move the pivot in and out of the dowel rod as it spins. Clean up the pivot and admire your workmanship. You now have a bright, highly polished (albeit not burnished) pivot, which will provide quite good service.

Admittedly, this method is not the same as burnishing, but it will yield acceptable results—certainly better than doing nothing when this is the only other option. I've seen folks drill holes into the ends of abrasive wheels and use them to do the same thing described above, but spinning the abrasive wheel in the lathe. The method described above gives a better overall result, yielding a cleaner and truer pivot surface. With this particular part (armature from a Style F self-winding clock), I have the option to disassemble (with some difficulty) and then spin the arbor in the lathe as before if the wear is severe. But there will be components where disassembly is just plain impractical, and that's when this method is a good choice. Just be sure that the paper strips are not wider than the pivot is long, or there will be a tendency toward a conical pivot.

Skipping any intermediate steps with the abrasive paper will not work, because the high polish is only obtained by successively increasing the grades of the paper, and finally, polish. However, if the pivot shows very slight wear, it's OK to skip the 600-grade

step and go directly to the 1,000 grade paper. For that matter, there is no harm in going directly to the 2,500 paper on very fine pivots or in situations where the pivot is only slightly scuffed. If the wear does not respond, you can always start back to 1,000 (or even 600) and work back up.

## What about the Ends of the Pivots?

Although not mandatory, it is a good idea to slightly round the end of the pivot after burnishing (or even before) and to remove any sharp machining burrs. Why is this? We do not have the sophisticated assembly fixtures used when the movement was originally built. As a result, during reassembly, rough pivot ends will catch on the brass plates and make assembly difficult. As sharp steel pivots are nudged into position, they will also scrape fragments of brass and carry them into the freshly cleaned and polished pivot hole environment. This must be avoided!

To prevent this, it is worth the time to do some cleanup on these pivot ends during pivot polishing. A highly burnished end is not needed. Once burrs or sharp edges are removed (can be done quickly with a very fine file or pivot file, or Arkansas stone), a few passes over the pivot end with a 4/0 buff stick will leave the surface smooth enough so that the brass plate is not scraped up during reassembly.

## Epilogue

Time has propagated many misunderstandings about proper pivot care and feeding. Many techniques can help, but it is difficult to find any method as effective as burnishing and finishing to a high polish. As with any methodology or skill in clock repair or clock making, proper pivot restoration will take some practice. Once you become proficient, you will find that your movements will run longer without developing premature wear indicated by the telltale black oil residue around the pivots. Then you'll know you are restoring movements that will run longer and more reliably, all other things being equal.

## About the Author

Ken Reindel has spent his 40-year career in various high-tech industries from precision test and measurement to photonics as a technical leader. He is currently working with a team of researchers in Lafayette, CO, developing new optical coherence tomography (OCT) swept laser technology.

He has spent the majority of his spare time since he was a pre-teen in the study of horology and in particular, techniques for the restoration and conservation of fine clocks.

For the past 20 years, he has specialized in self-winding and electric clocks, but he enjoys everything from alarms to Vienna Regulators. Through Ken's Clock Clinic at www.kensclockclinic.com, he supplies electric clock enthusiasts with numerous electronic devices to power and synchronize these clocks.

He enjoys presenting programs to NAWCC Chapters, conducting classes, authoring articles, and apprenticing interested folks.