Rockin' the Rockers

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I'm spending my spare time these days rebuilding a 1974 Triumph TR6. I had the well-worn 2.5 liter straight six engine all apart, and was assessing the toll that 40 years and close to 100,000 miles had taken on the moving parts. After addressing the usual deceased cylinder bores, crank bearings, camshaft and such, I came to the valve train. The TR6 valve train includes conventional solid cam followers, vertical push rods, and 12 ordinary rocker arms mounted on a common shaft.

The shaft and rockers had pretty severe wear commensurate with the rest of the engine [Figures 1 & 2]. It bothered me that the valve train design didn't include any bushings for the rockers on the rocker shaft. Other TR6 enthusiasts have noticed this, too, and have created a demand for aftermarket bushed rockers, which a number of suppliers are gladly providing. There are also outfits that will bush the stock rockers.

Figure 1. The rocker shaft shower pretty severe wear.

Figure 2. The rocker bores also had deep scoring.

While I was mulling over the $16-$18 price for each new bushed rocker, I glanced over at the knee mill my wife let me buy because I told her how much it would save us in rebuild costs. In the end, I decided to try to recondition the old rockers myself, and what follows is the story of that project.

Of course, installing a bush is not rocket science, but this application had enough twists to make it interesting. First, there isn't much meat on the bottom side of the rocker--as little as about 0.150" on some of them, so I wasn't crazy about losing nearly half of it to a 0.062" wall bushing. I couldn't find right sized bushings with any thinner wall from my usual suppliers, so I decided to open up the bore by 0.062" (0.031 all around), press in a 0.062" wall bush, then bore and ream the ID of the bush, leaving a nominal 0.031 wall thickness.

The other thing that made this job a little trickier is work holding. The rockers are odd-shaped, with only a couple of machined surfaces. Luckily, one side of the rocker is flat, and I thought there was just enough meat on the other side to get a couple of clamps on. To hold the rockers securely, and allow reasonably easy setup for each of the 12 rockers, I made the fixture shown in Figure 3.

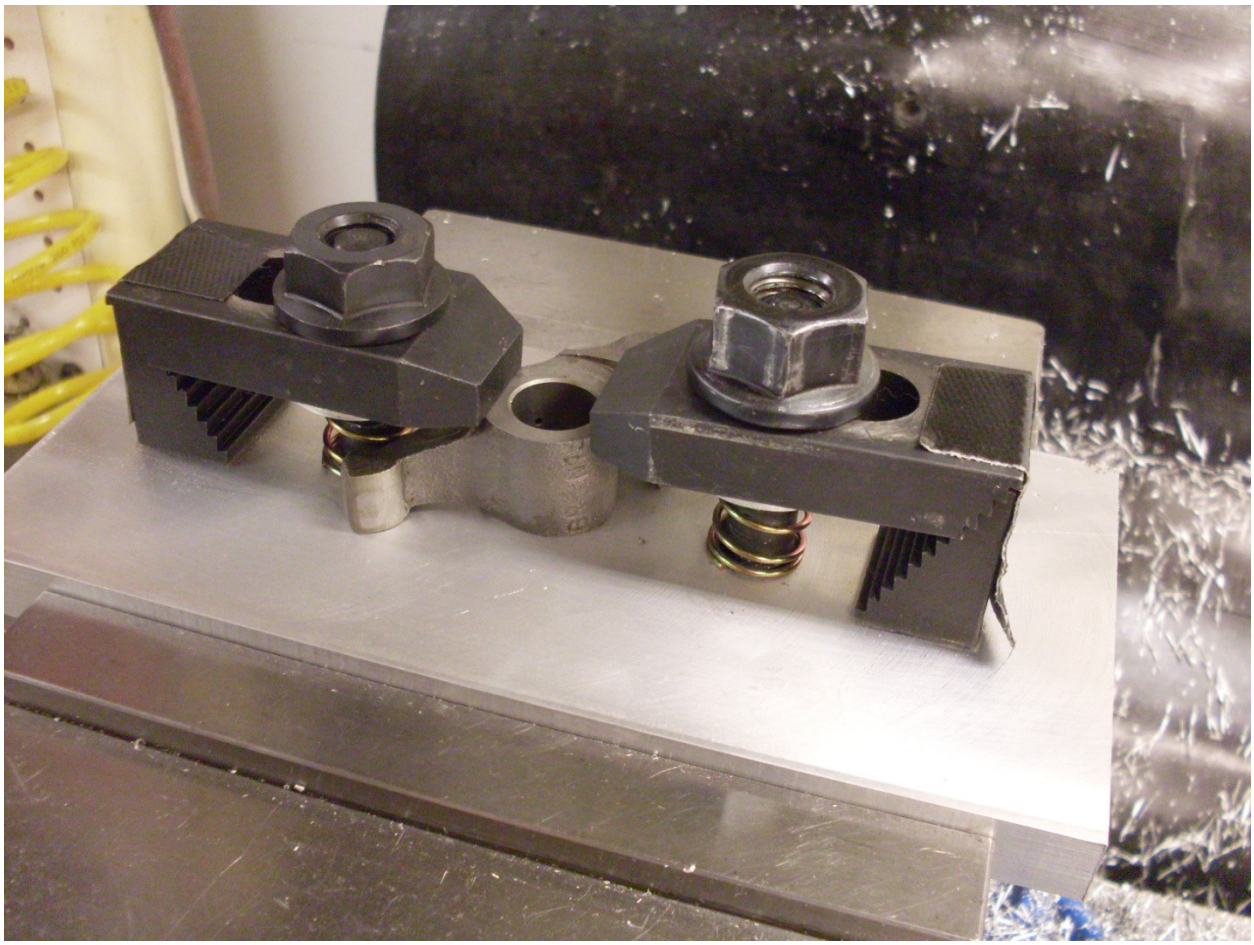

Figure 3. The rocker bushing fixture.

The fixture consists of a 1/2" thick aluminum base plate, milled flat and square, fitted with a couple of clamp bolts. On each clamp bolts is a spring, a washer, and an ordinary finger-type mill clamp. The rear of each clamp is held up by a pair of adjustable step blocks. I stuck the bottom step blocks to the plate with some double stick tape, and secured the clamp to the step blocks with some Gorilla tape, forming a hinge. All this was to allow me to easily swap rockers in and out of the fixture without everything falling apart or needing four hands. The fixture also had a stud extending vertically in the rear for the rocker arm to rest on to keep it from rotating.

I secured the fixture in the vice, and clamped in the first rocker. I then indicated the rocker bore so that it was centered on the spindle axis, and locked the X and Y table axes.

I drilled the nominal 9/16" rocker bore out to 15.5 mm, then reamed it to 0.625 [Figure 4], which is 0.001-0.002 smaller than the actual bush ODs. I then used the mill and a purpose-made drift to push in a 5/8" x 9/16" x 3/4" Oilite bushing [Figure 5]. The bush was then drilled to 14 mm, and reamed to 0.5625 [Figure 6]. This was all done without disturbing the setup, so everything remained concentric.

To position the next rocker the 9/16 reamer from the final step was used to align the part to the spindle axis for clamping.

Figure 4. The rocker after being drilled and reamed to accept the bronze bush.

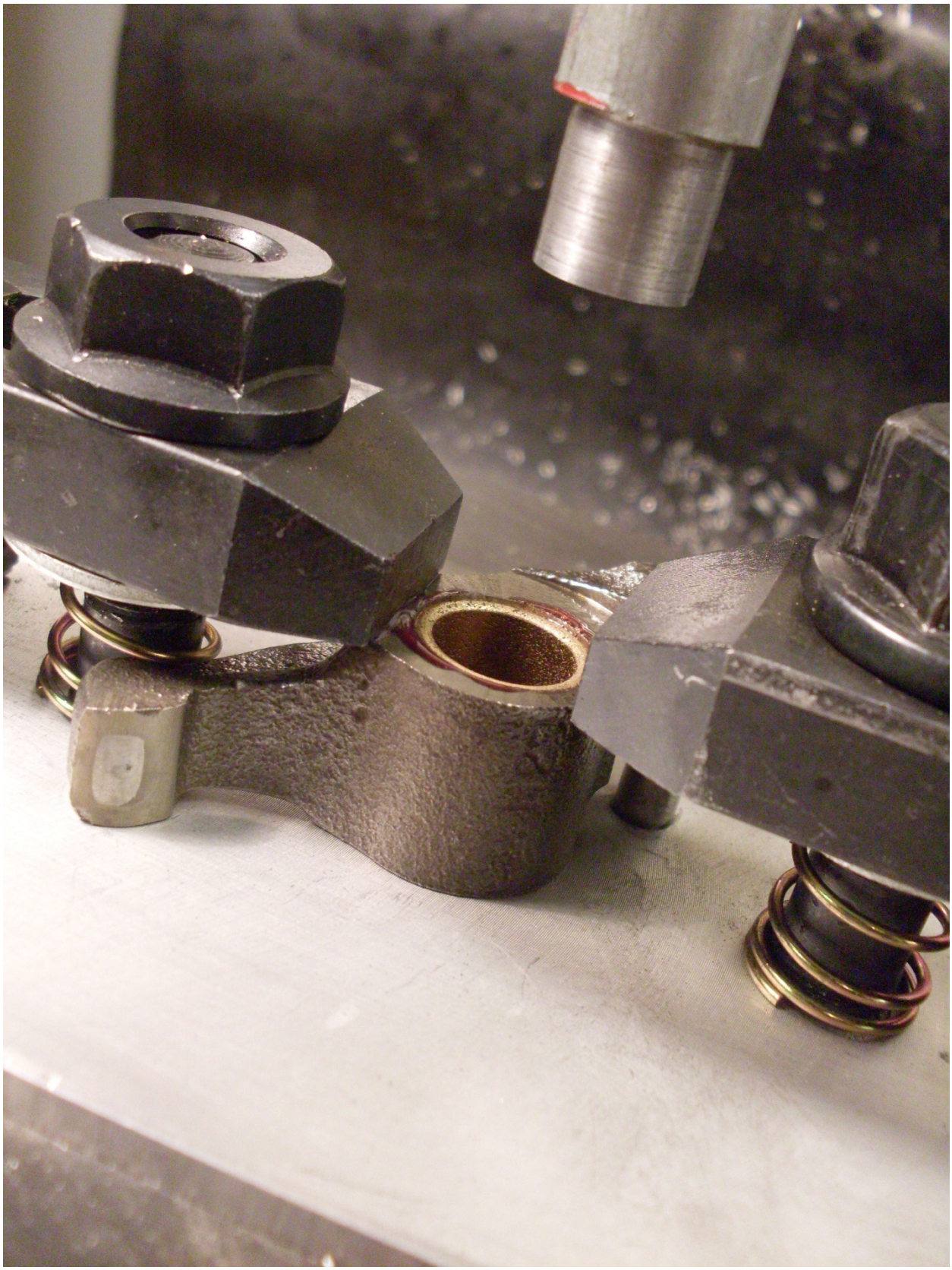

Figure 5. After the bush is pressed in with a purpose made drift.

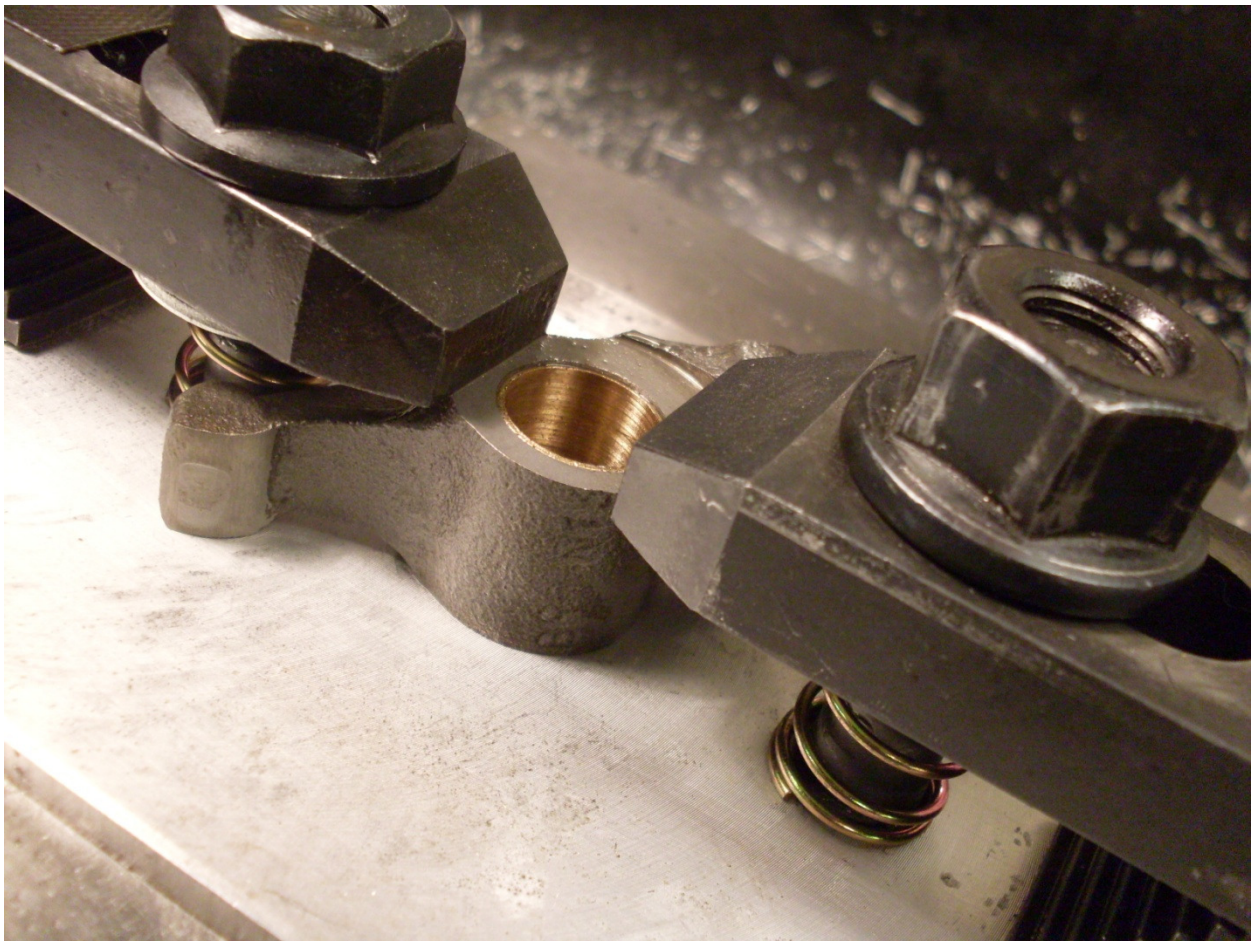

Figure 6. After the bush is drilled and reamed to fit the rocker shaft.

The initial drilling of the first rocker bore continued all the way through the fixture plate to help clear the chips for all of the following operations.

This all went remarkably smoothly and quickly, and the only slight glitch was that the 14 mm drill wanted to grab the bush. I fixed this after the first occurrence by dulling or "dubbing" the cutting edge of the bit.

The last step was to chamfer the all of the bushes for a neater look, and so they wouldn't be proud of the rocker body. This was done with the table still locked in the same position. I used a little adapter to center the rockers on the previously drilled hole in the fixture plate. The adapter was also necessary because one side of the rocker is not flat [Figure 7].

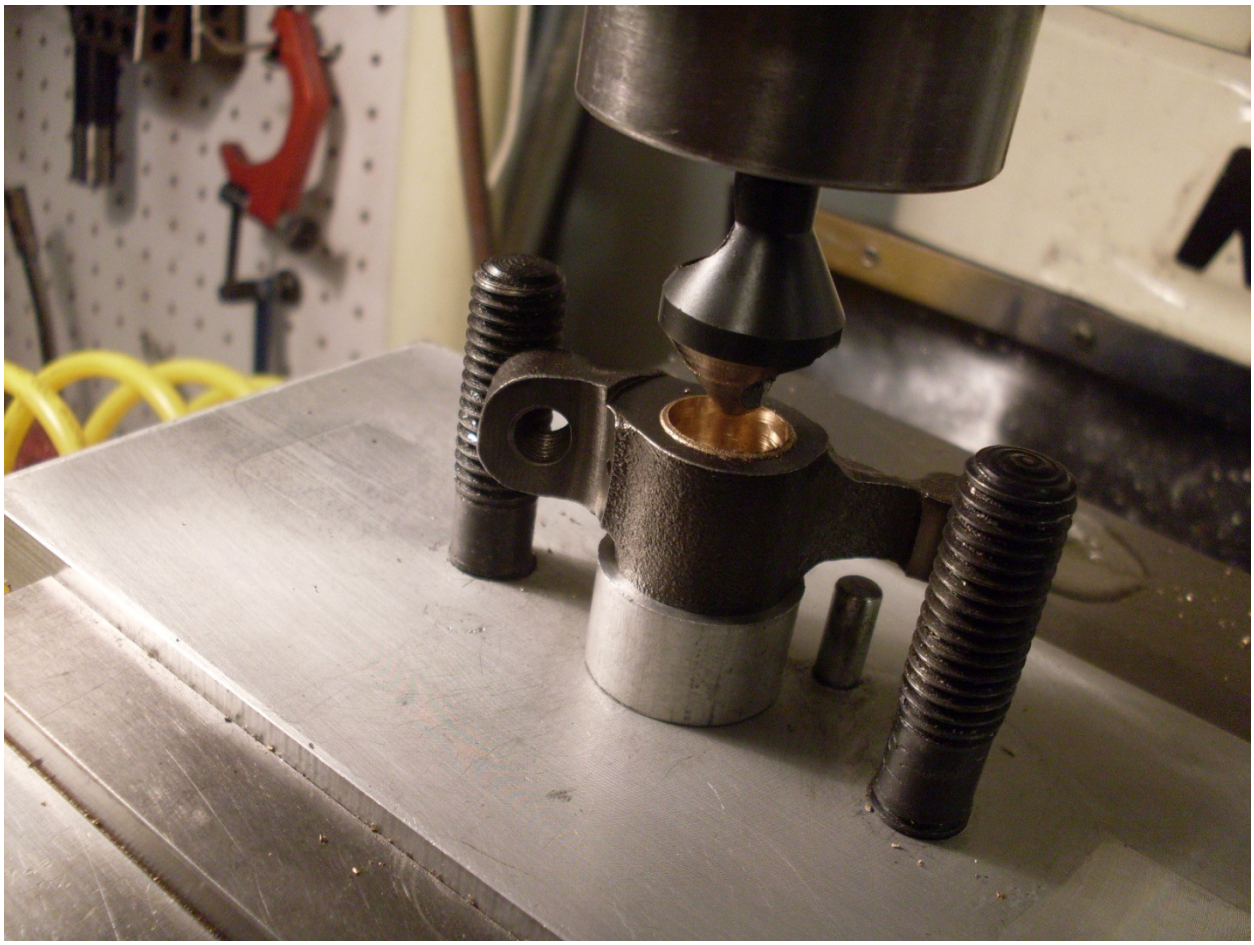

Figure 7. A rocker on the centering adapter for chamfering.

Finally, I drilled the existing oil holes through the bush [Figure 8], The finished bushed rockers look pretty good [Figure 9].

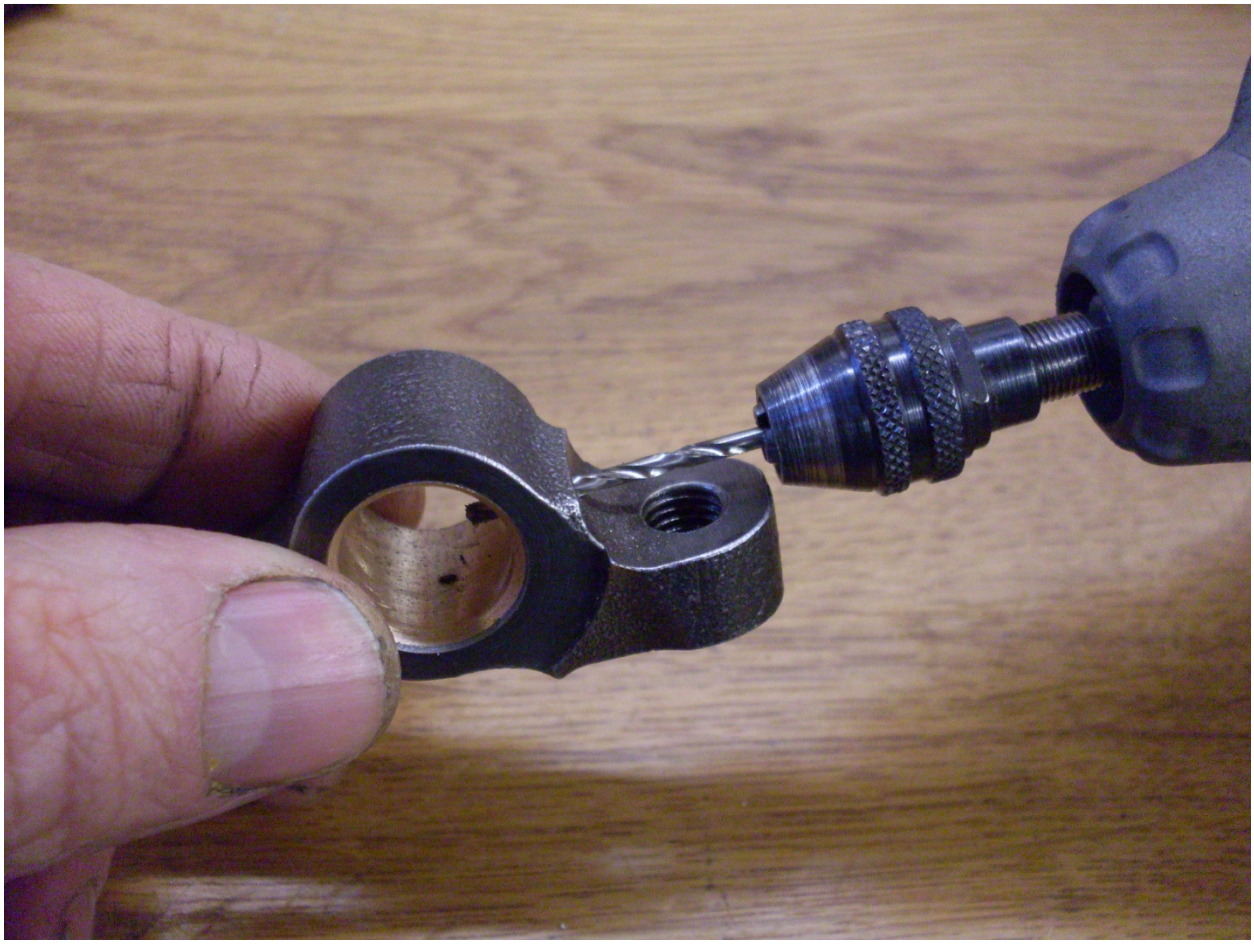

Figure 8. Drilling the oil passages through the bush.

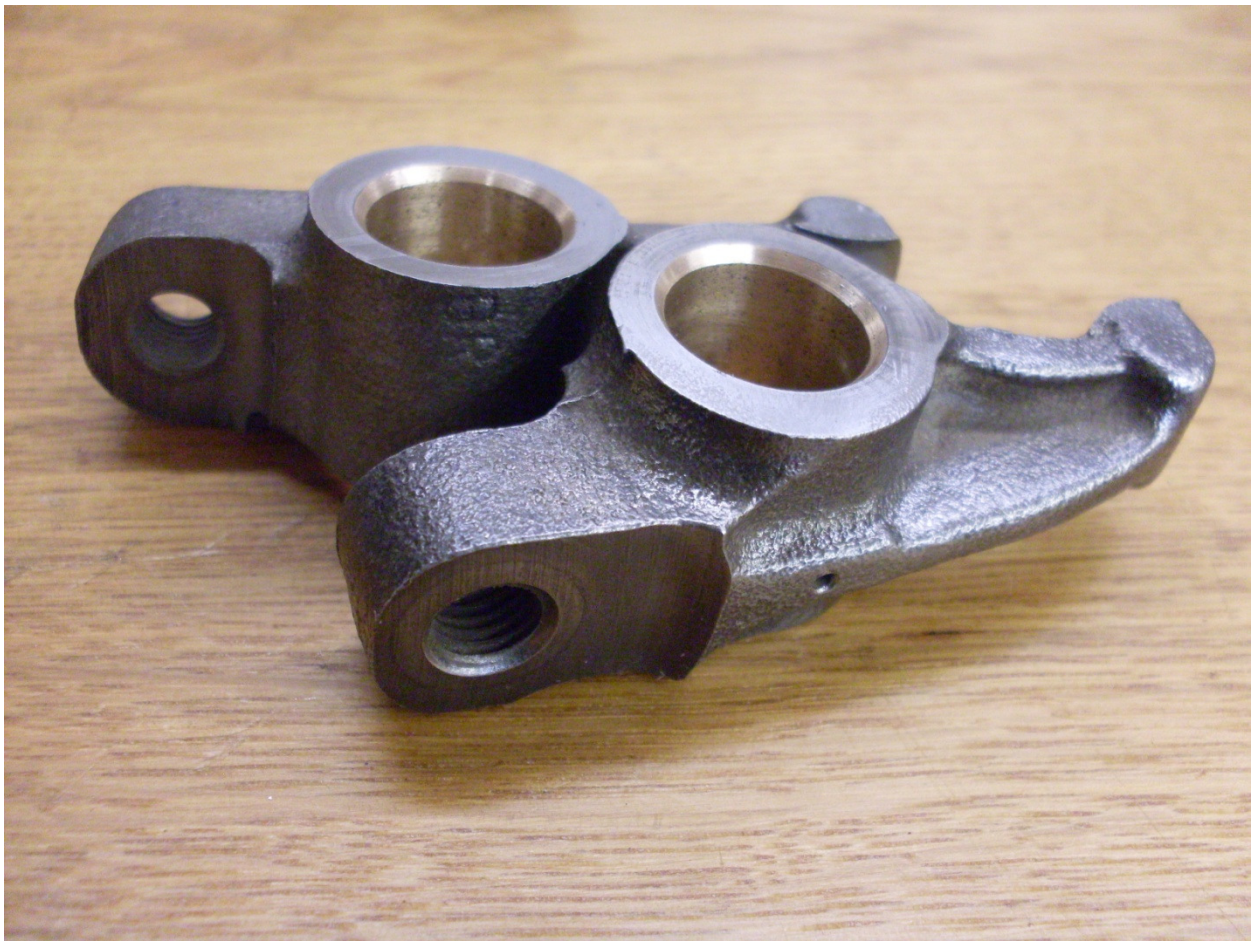

Figure 9. A couple of the bushed rockers.

So this took care of the bushes for the rockers. The next issue was the worn tips of the rockers where they contact the tip of the valve stem [Figure 10].

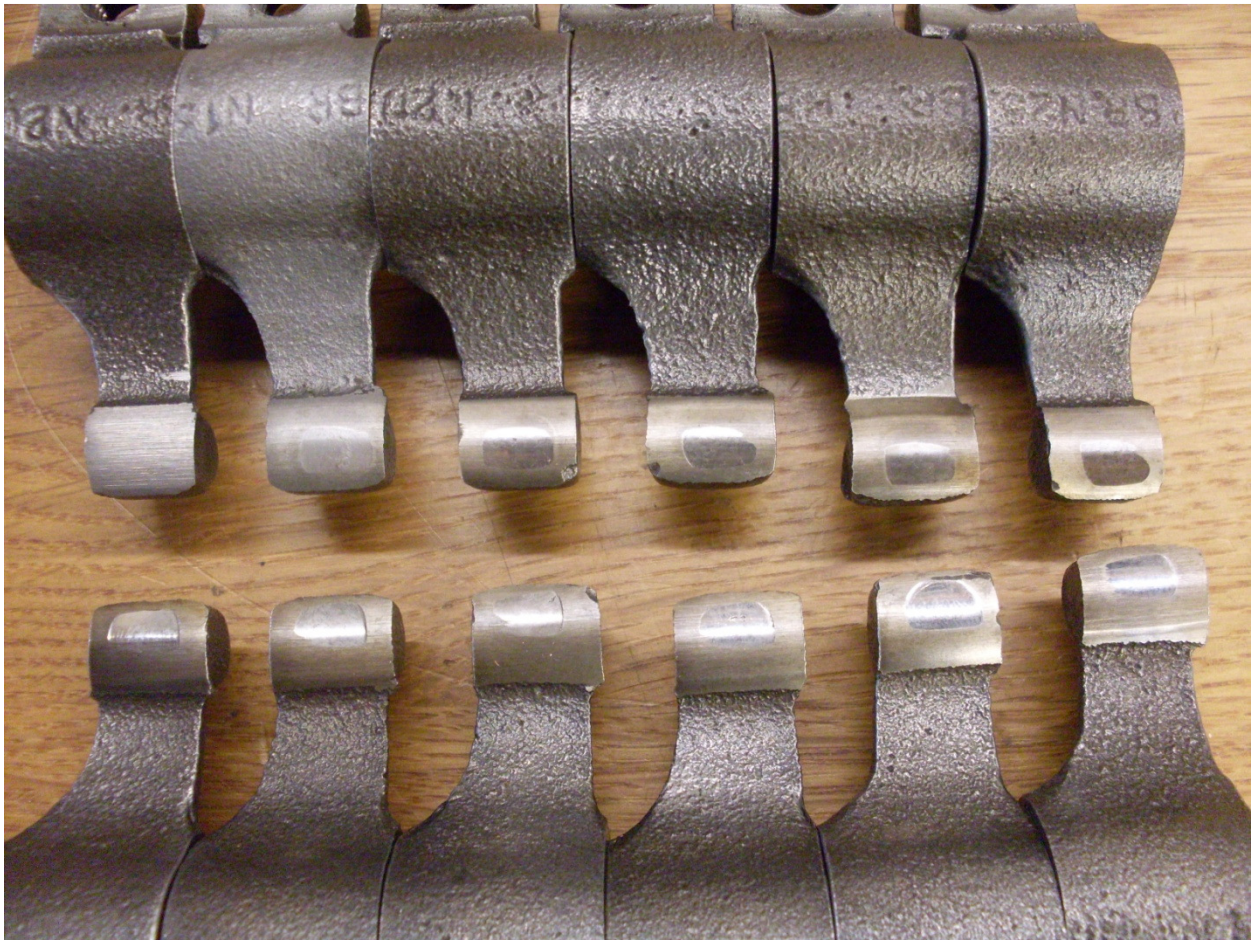

Figure 10. The wear patterns on the rocker shoes.

The "shoe" of the rocker is the part that contacts the tip of the valve stem, and on these rockers it appeared to be a section of a cylinder with a radius of about 5/16". As the rocker rotates downward, the contact patch with the valve stem moves outward on the shoe, so there is some "rolling" action at this joint, but there is some sliding, too. There were definite wear areas on the shoes, but they all appeared to be relatively superficial. I wanted to clean these up and restore the original profile to the shoes.

I made the jig shown in Figure 11 to mount on the table of my little 1 inch belt grinder. It consists of a carrier that holds the rocker arm, and a base with a hole that the carrier pivots in. The carrier has a vertical cylinder that is a slip fit into the rocker bore, and a stop block. The rocker's lash adjuster bears against the stop block to adjust the angular position of the rocker on the carrier. The carrier also has a

pin on the bottom side that fits into the pivot hole in the base plate. To set up the jig, first the base is positioned so that the pivot hole center is 5/16" from the abrasive belt. This sets the radius of the new ground surface on the rocker shoe. To get this measurement right, I made the little 5/8" diameter gage that fits in the pivot hole. The base is set, and then clamped to the grinder table [Figure 12].

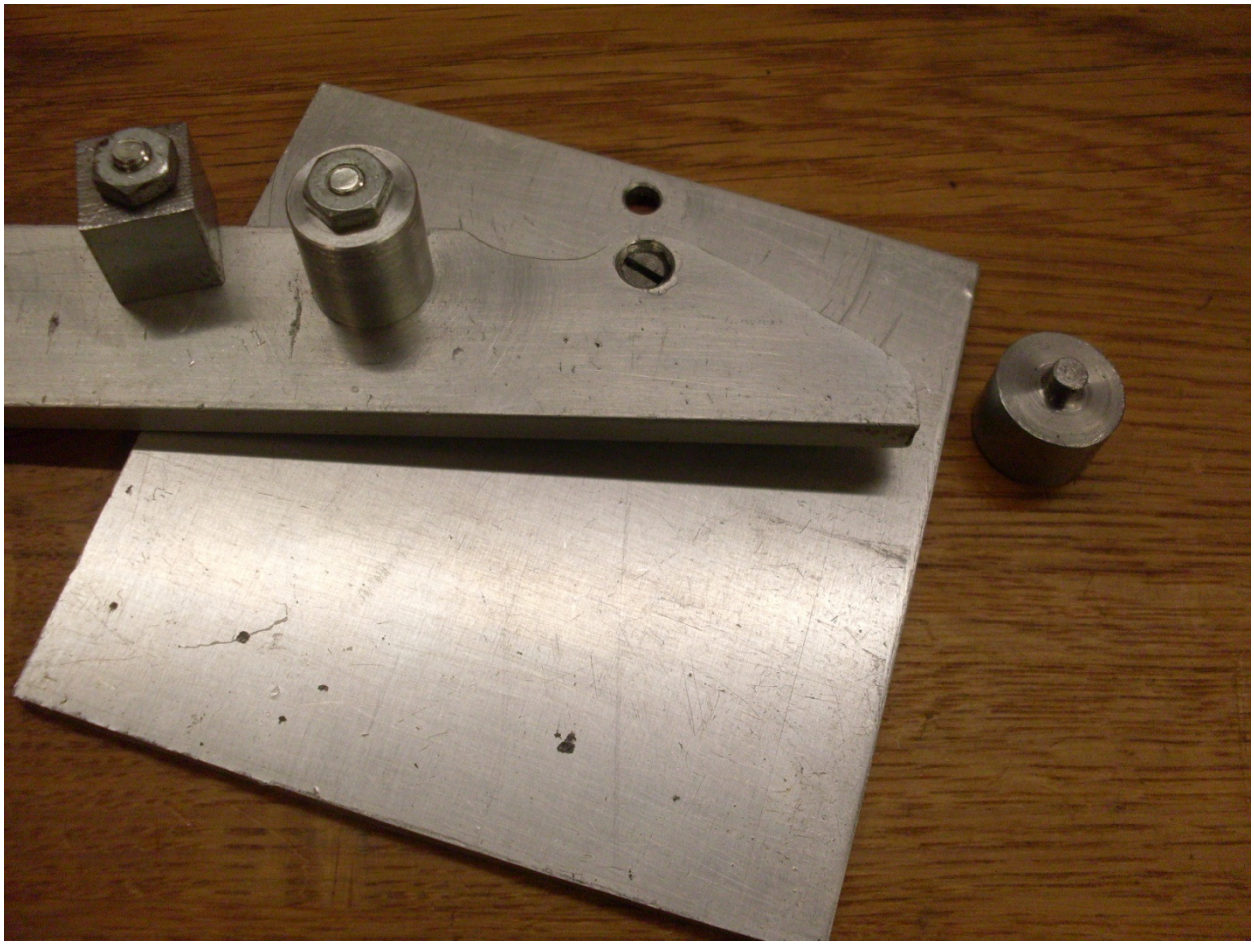

Figure 11. The rocker shoe resurfacing jig.

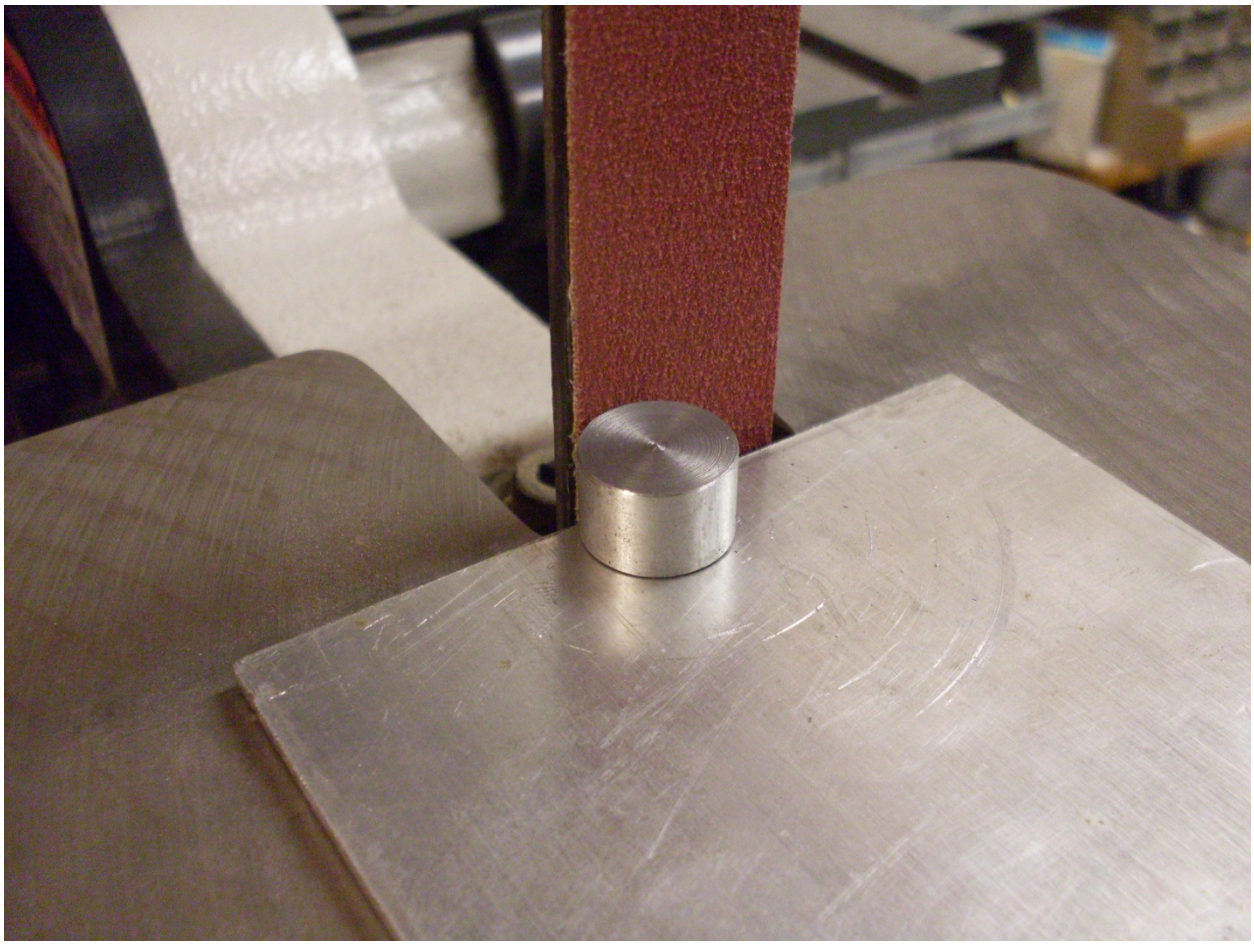

Figure 12. The 5/8" OD gage sets the radius for the shoe.

The carrier is then mounted on the base, a rocker loaded on the carrier, and the lash adjuster set so the rocker shoe just touches the abrasive belt [Figure 13]. The carrier is then rotated through enough arc to clean the entire shoe. The process is repeated with small adjustments to the lash adjuster until the worn areas are gone. On the worst rocker, it took less than 1/4 turn of the 5/16-24 adjuster to true up the shoe. This calculates to a little less than 0.015" of material removed, accounting for the 1:1.4 rocker ratio. Figure 14 shows a comparison of before and after the resurfacing operation.

Figure 13. A rocker on the jig ready to be cut.

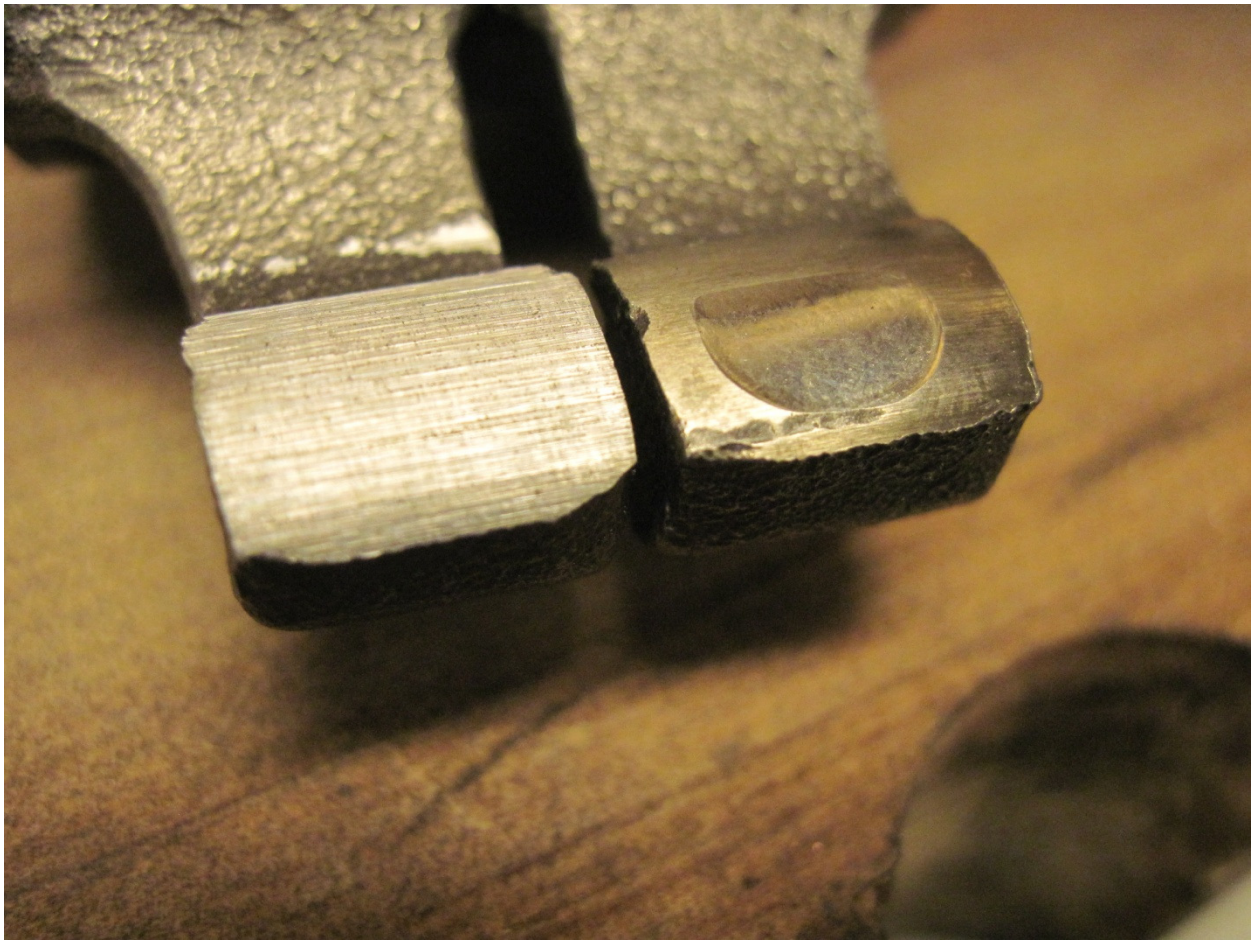

Figure 14. Comparison of worn and resurfaced rocker shoes.

I was a little concerned about maintaining the hardness of the shoe surface, since I wasn't sure if there were any surface hardening done on the parts. A simple file test suggested that there wasn't too much difference in the hardness of the original and the new surfaces. While not definitive, it eased my mind.

The last step was a few passes with a fine stone to smooth out the grinding marks [Figure 15].

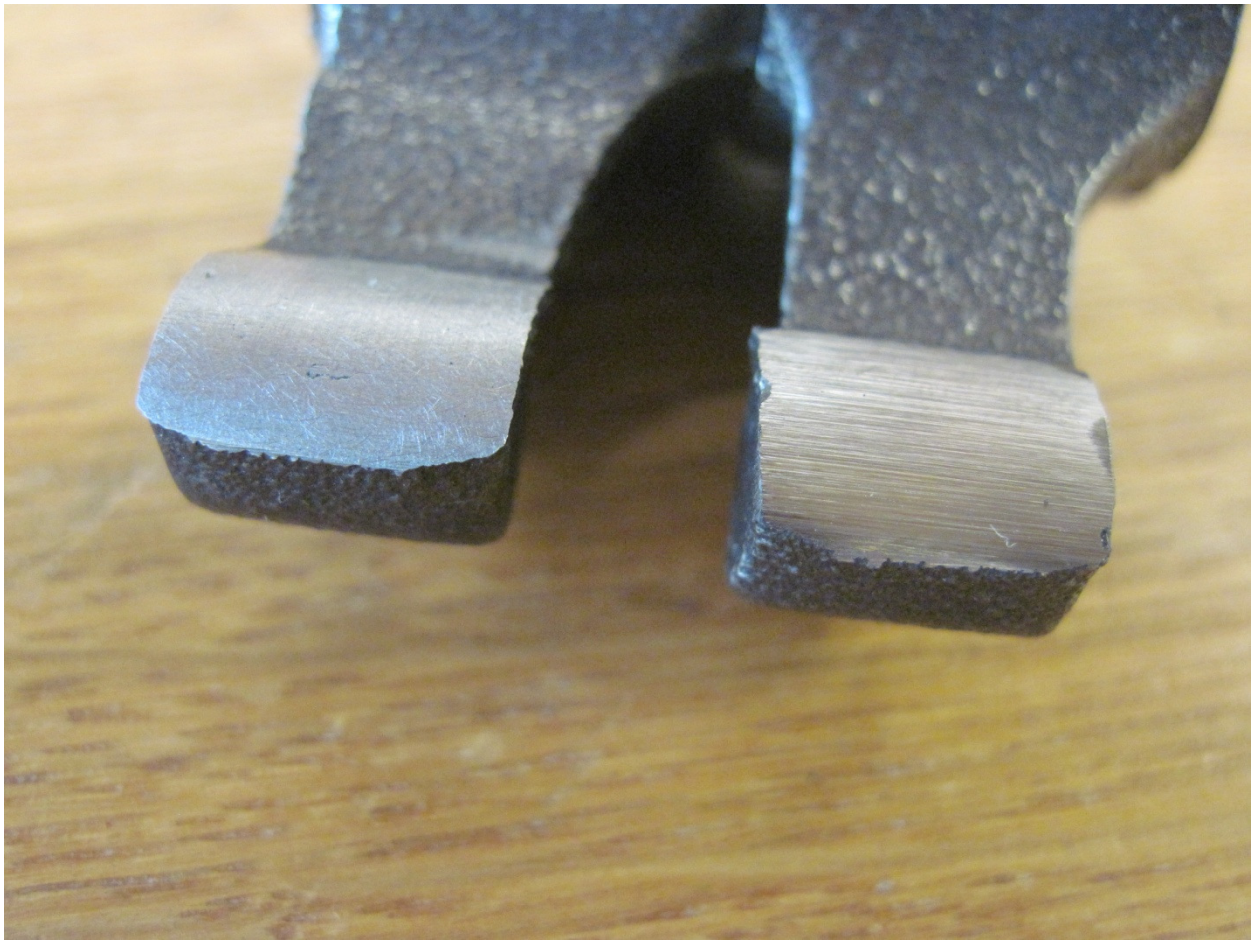

Figure 15. A fine stone was used to remove the rough grinding pattern.

Granted, the total project was a fair amount of work, but for the $100 cost of the drills and reamers, I got a $200 set of bushed rockers AND the tools, not to mention a nice challenge, some good experience, and a story to tell.