South Bend 9” Compound Slide Screw Fabrication
For a Large Dial/Thrust Bearing Conversion

By

Ed Godwin
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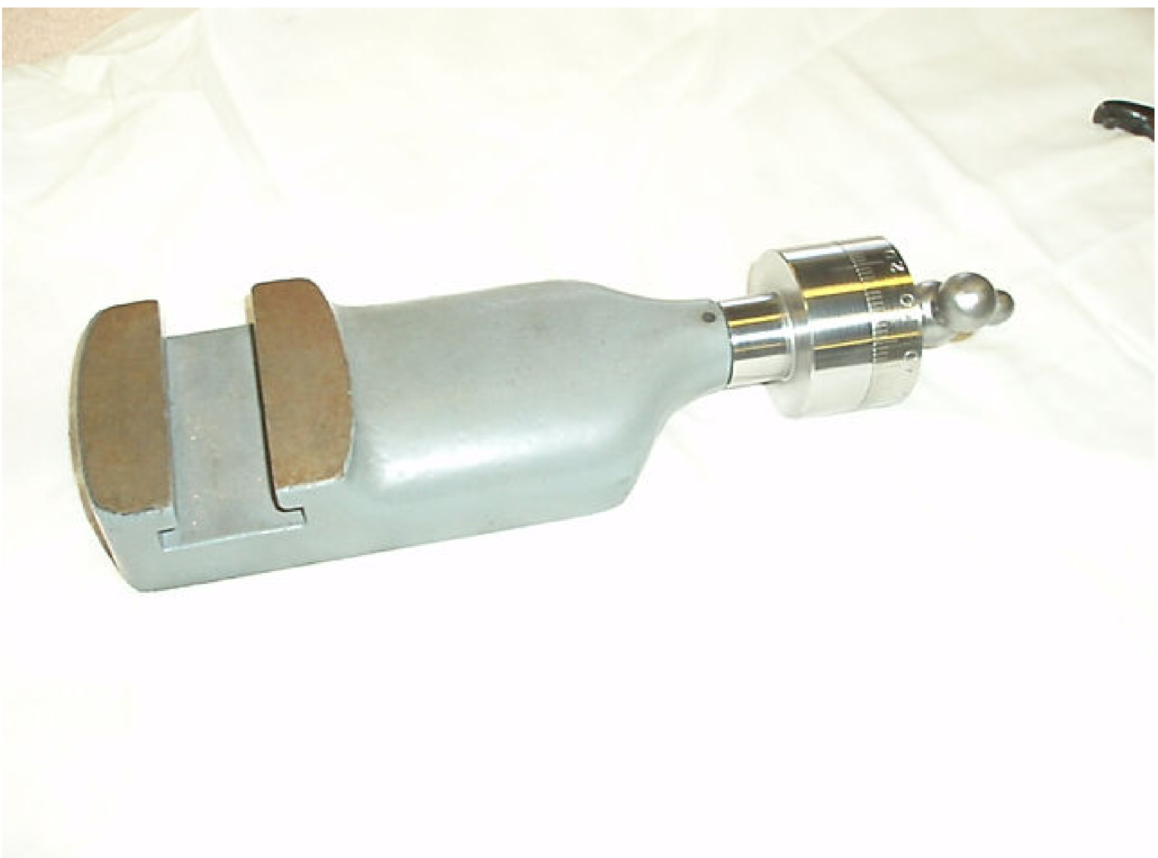
This series will document the machining and assembly of a South Bend Large Dial Compound Slide Screw with anti-friction thrust bearings. All parts were created from blank stock with the exception of an original South Bend ball crank handle and the two needle thrust bearings.

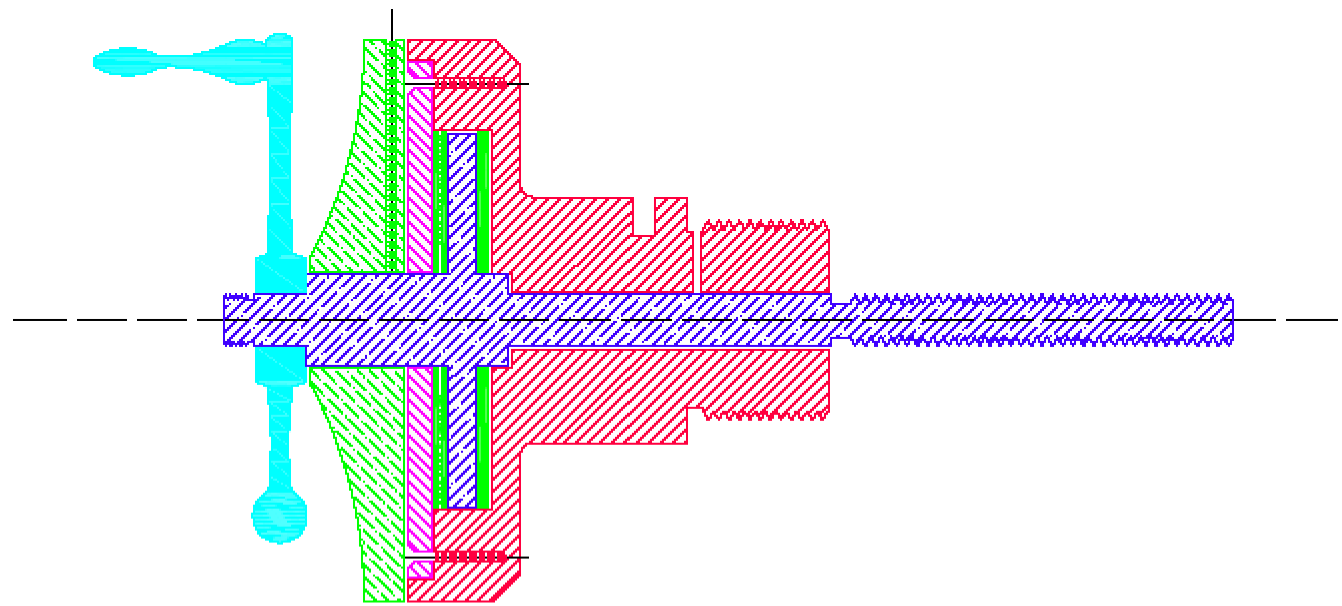
This work is part of an upgrade to “A” model features of a 9” 1936-vintage South Bend Workshop (Model 415) lathe.

Shown in the next photograph is the way things will look when the project is complete. Note that this is for a large dial assembly. Small dial assemblies will have considerably different dimensions and I don’t believe you can convert them to accept thrust bearings.

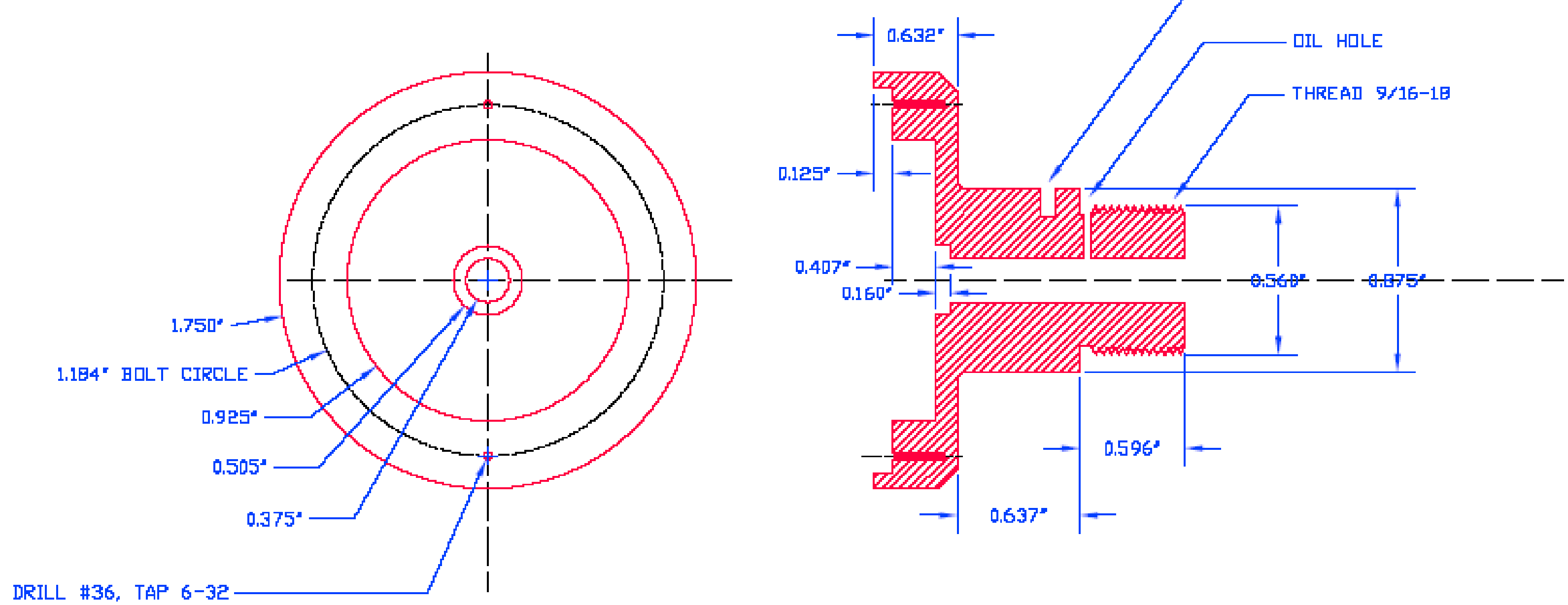


You’ll find herein dimensioned drawings with two different versions – the long bushing version shown and a short-bushing version which would be more like that supplied originally with South Bend lathes equipped with the large compound dial.

First, the drawings: They are not to scale.



ASSEMBLED COMPOUND SCREW WITH NEEDLE THRUST BEARINGS
AND LARGE DIAL FOR SOUTH BEND 9" LATHES



BUSHING AND BEARING HOUSING

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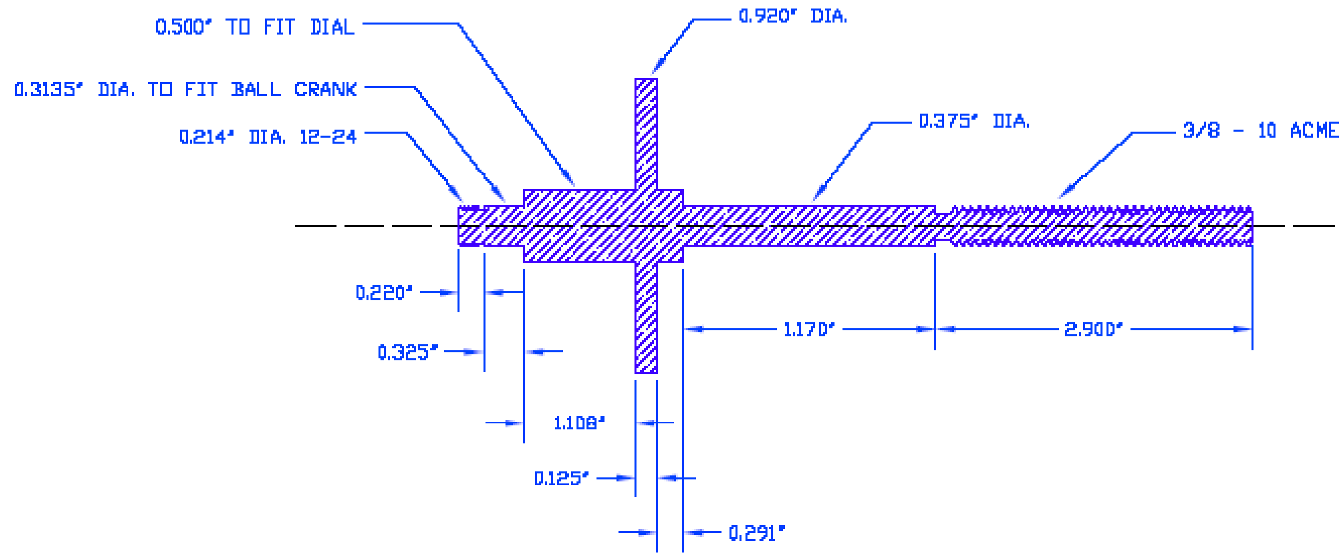
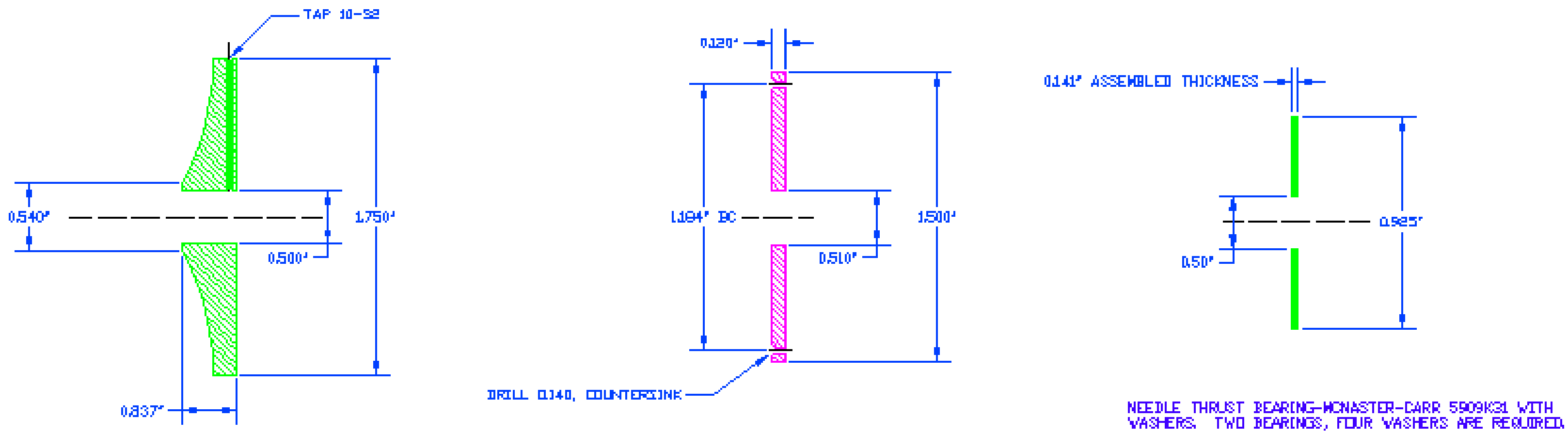
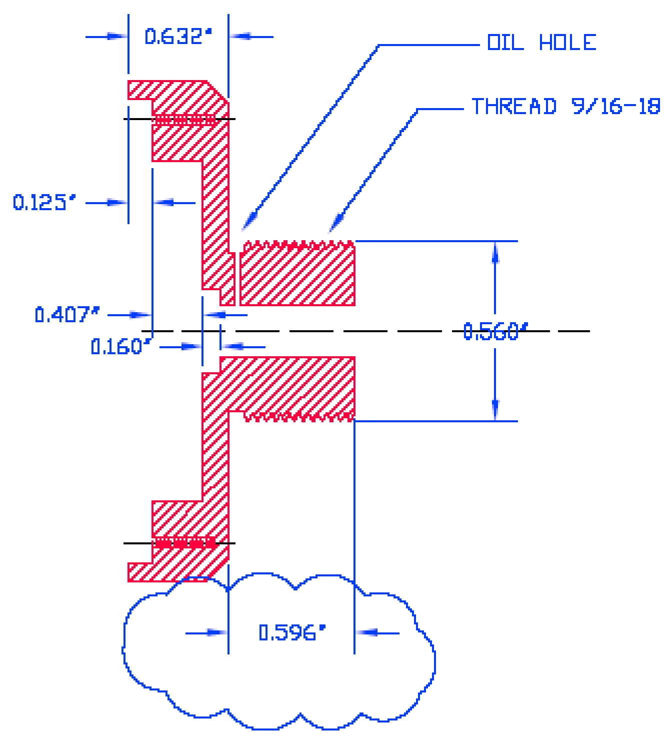


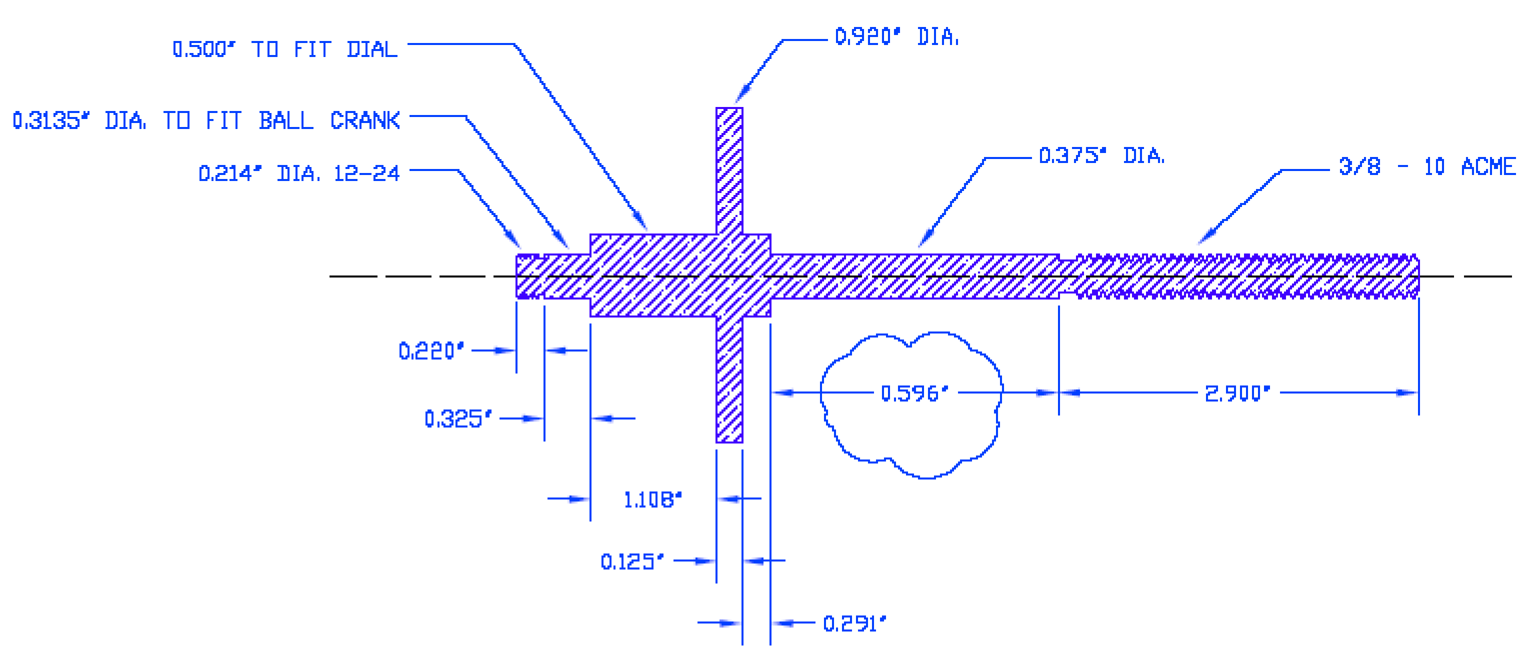
LEAD SCREW - CUT ACME THREADS TO CENTRALIZING FITS TO MINIMIZE BACKLASH



DIAL, RETAINING RING, AND THRUST BEARING



ALTERNATE BUSHING AND BEARING HOUSING



ALTERNATE LEAD SCREW

Shown below are the original lead screw, bushing, and graduated dial. Note how small everything is – I can barely see the mil graduations on the dial and it is in very good shape despite being 71 years old. Must be me, eh?

The new parts are shown below the original. Note the thrust ring machined into the one–piece lead screw. The two thrust bearing sets are shown. Each bearing requires two washers that are ordered separately from the bearings. Each assembly is about $4 from McMaster-Carr.

The machined surfaces that the bearings bear on should be carefully cut to be very flat and perpendicular to the lead screw shaft. The bearings can and will deflect under load and you want all the load to be transferred to the beefy components.

A strong word of caution: Even though I show an assembled bearing thickness on the drawings, you should measure yours individually and then adjust your final dimensions on the lead screw and bushing counterbores to reflect that. Manufacturing tolerances on the bearings can vary by a few thousandths and you will be working your final assembly to a thousandth.

The retaining ring is shown with four screw holes but you only need two. Since this is a beta version, I made a mistake and over-engineered this.   OK, I'll admit it, I also broke off a 6-32 tap in the bushing so could only use two holes anyway. An alternate is to thread the retaining ring and insert the screws from the outside rear of the bushing. I considered this but didn't want the screws to show. You can decide for yourself if you want to take the risk of tapping these small holes in a high-value-added item like the bushing versus the aesthetic of hiding the screws.

Shown is the bushing from the ball-crank end with the lead screw and bearings installed. Bearings are intentionally designed slightly loose on the lead screw and in the counter bore of the bushing.

The outer bearing's washer should sit proud of the counter bored surface by one or two thousands so that the retaining ring can bear on it. The amount of drag on the bearings will be determined by the screw tension. Once you've got this set, you might want to use some pipe dope on the threads. I wouldn't use even the temporary Lok-Tite since the screws are so small.

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Another view, this time with the retaining ring and screws installed. The retaining ring and screws should sit below the outer raised ring of the bushing slightly, maybe 0.005”. You want the dial to have about 0.001” clearance to the bushing ring. The additional clearance between the dial and the retaining ring allows swarf, etc. a place to hide (it’s gonna get in there anyway) without eroding the bushing and dial face.

You need a little clearance between the shaft’s half-inch diameter and the ID of the retaining ring.

I thought about adding a bearing oiler hole to the bushing but decided that the bearings would get enough oil without it and another hole was just another entry point for dirt.

This view shows the spanner hole. Room for the spanner wrench was one reason why the bushing was made longer than the SB original. Another was that I wasn't sure I'd have enough room for the bearings, etc. without a longer bushing. It turns out that I needn't have worried. The 0.100" depth on the large end of the bushing is enough so you can make the bushing shorter if you like. You'll see later on that you might want to make the bushing shorter due to ball crank interference with the cross slide screw ball crank.

When the bushing is screwed into the compound, the spanner hole is at the 8 o'clock position, just to keep swarf and old oil out of it.

Not shown is the oil hole to match up with the oil hole in the top of the compound. Drill the spanner hole first so you can tighten the bushing up hard in the compound, then center punch through the compound's oil hole to mark the spot. This way they'll be aligned. Now's also the time to mark the 12 o'clock position on the bushing OD for your witness mark.

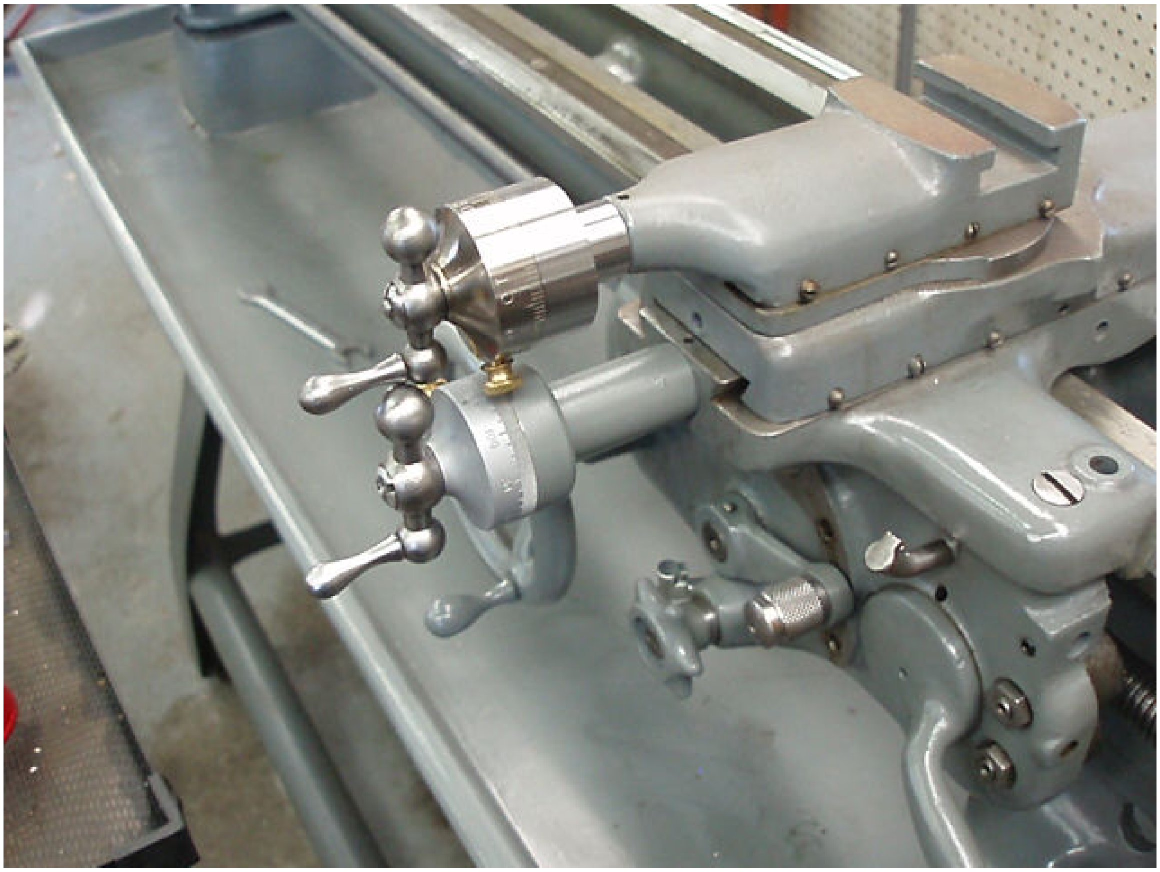
Also note the 3/8-10 ACME lead screw. These threads were single-point cut on my clapped-out old 13" SB. They are very accurate and smooth. The key is grinding and honing your threading tool carefully. If I had an optical comparator I could do an even better job, but some good magnifying lenses suffice.

With the new graduated dial. It is important that the steps on the lead screw shaft be carefully measured and cut. You will want to end up with about 0.001" clearance between the dial and the bushing when the ball crank is tightened down. The tight clearance is just nice workmanship of course, but it also helps to keep the junk out of the works.

Please forgive my sloppy number stamping. I was going to make a jig to hold the stamps but I couldn't get to it and it shows. I promise to do better next time, honest.

This is what we've been waiting for. Assembled on the lathe. Note though, how the ball cranks interfere. The dials do not interfere with each other or the ball cranks. The brass dial locking screws do interfere with each other and the ball cranks, so they'll be modified to a lower profile. Hate to do it since they're so easy to use as they are.

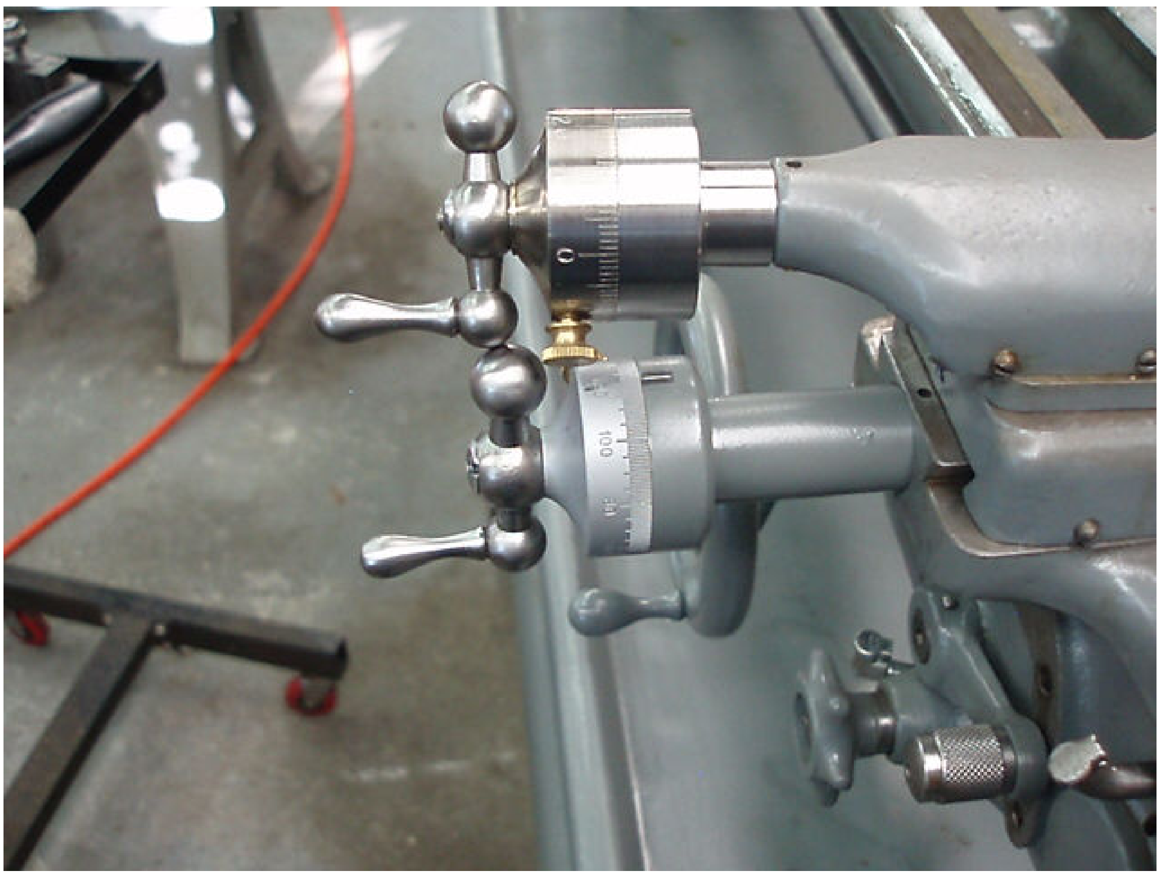
If the bushing was made shorter, it would provide an additional 0.600" of compound rear travel before interference. It seems to me that the best solution would be to trim the ball cranks. Trimming about 100 thou off each end of each ball crank would solve this problem entirely.

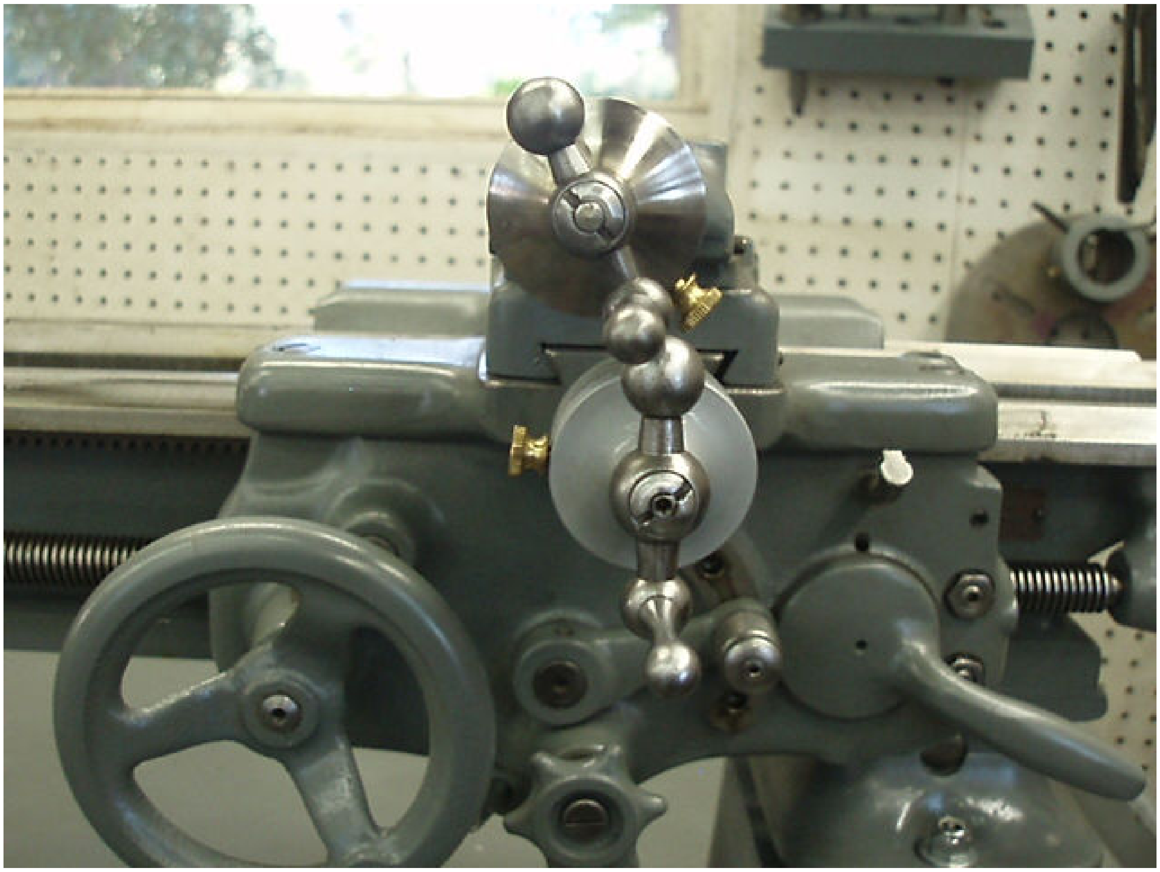


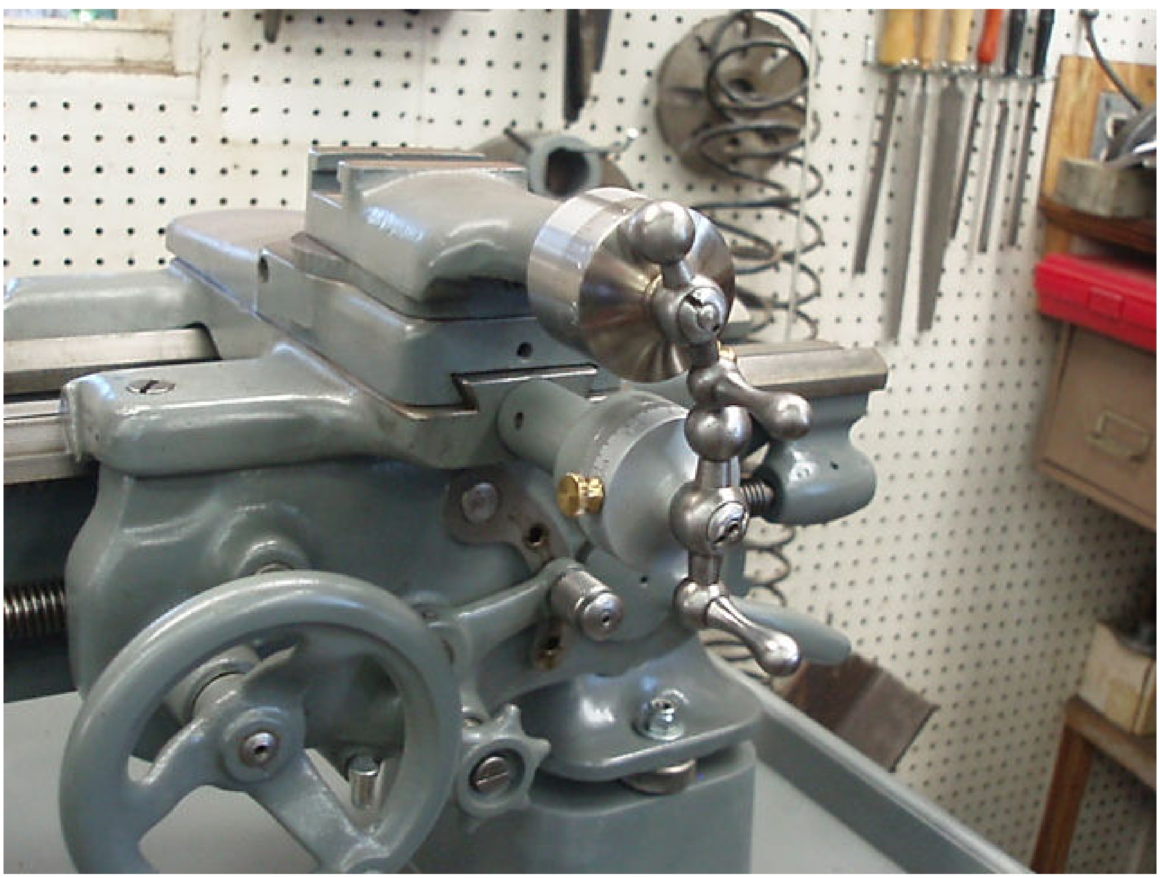
Another shot of the interference.

The graduated dial was turned out on the 13" lathe. The radiused face was created by roughing out the surface with a single-point cutter and then smoothing it out with a file and emery paper, strictly by eye. It really only took about an hour total to make this dial blank ready for graduating. While I graduated it on the mill with a dividing head, there's no reason why it can't be done on the lathe. There are many methods for this that include:

- Rigging a 100-tooth gear and pawl at the left end of the spindle
- Measuring the perimeter of your chuck and dividing it into 100 equal spaces, then using a CAD program to make and print out a paper ring and taping it to the chuck. That's how I made the index plates for my homemade dividing head which was designed by the late Phil Duclos. There are also manual layout methods for pencil drawing a quite accurate paper ring.







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Finally, if you look at the bottom foot of the lathe, you'll see a knurled ring. That's a leveling ring that threads (3/8-24) on the mounting stud. To aid this function, the bottom of the lathe's feet were milled parallel with their tops. There are two of the adjustment rings under each foot and they are immensely useful in "leveling" the lathe.

The chip pan is a solid piece of ½" MDF that is sealed with polyurethane sanding sealer and painted. The risers are made from glued-up pieces of ½" MDF, angle cut on the band saw and sanded to round the contours to match the feet. The chip pan lip is made from pieces of solid oak to resist denting. The chip pan sits on a welded steel pipe and leg frame with ½" thick steel plates under the headstock and tailstock feet. Lathe mounting studs secure everything to the ½" steel plates. The legs are equipped with rough leveling screws in them. Very solid.

I hope you enjoyed this little project. Comments, criticisms, and just plain kvetching can be aimed at me on the Yahoo South Bend Lathe group and also at my email: eng4turns@yahoo.com

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