CONVERTING A SOUTH BEND HEAVY 10 SMALL DIAL CROSS-FEED TO BALL/ROLLER BEARING TO REMOVE AXIAL PLAY.

One of the most common questions about South bend lathes is:" How do I remove the play in the dial?"

There are two sources of play; the screw and nut and the axial play caused by wear on both the back of the pinion gear/threaded sleeve and wear on the calibrated dial.

Figure 1 shows the components of the small dial assembly.

Figure 1 South Bend Heavy 10 Small Dial Cross-Feed Assembly.

On the bottom is the nut and shaft with the pinion gear. The left side of the threaded sleeve, next above the screw, buts against the pinion gear, Lubrication and cleaning of these surfaces are iffy and usually there is some wear. The calibrated dial or sleeve turns on the shaft there must be some play, one of two thousands of clearance in the space between the back of the handle and face of the threaded sleeve. Both are open to swarf and may or may not be oiled. When feeding in the calibrated dial is pushed by the handle

against the face of the threaded sleeve and wear occurs. Over the years the one of two thousands of clearance can easily grow to ten to fifteen thousands of an inch.

On the large dial Heavy 10” and other lathes with large dials Southbend corrected this problem by adding ball bearings at tow critical places.

This note will show how to adapt the small dial cross-feed to contain bearings and what adjustments are needed to remove all the axial play forever.

In Figure 2 you will see the added components. This note details their installation and construction.

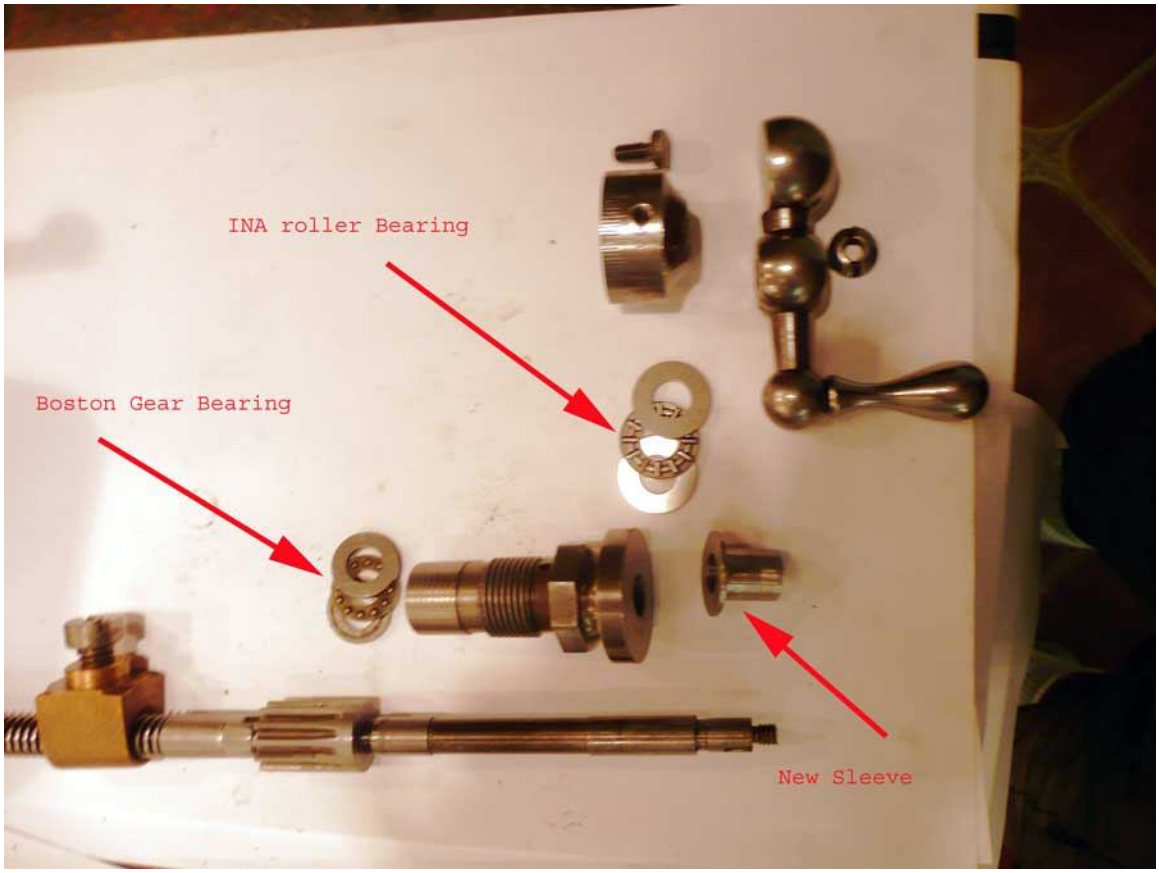

Figure 2 The Modified Assembly; Two Bearings and a Sleeve are added.

The modification consists of adding a pair of thrust bearings, one ball and one roller, machining existing components to accept the bearings, drilling out the calibrated sleeve to accept a new inner sleeve and turning the new inner sleeve.

The general process you will follow is:

1) Obtain the two bearings listed below.
2) Measure the end play in the dial with a feeler gage

3) Fit the Boston Gear bearing to the shaft by turning back either the end of the threaded shaft or turning back the rear of the pinion gear or both.
4) Run an 11/16 drill by hand through the cross slide casting to insure the bearing will fit.
5) Drill the calibrated sleeve/dial thru ½"
6) Bore a step for the INA bearing. (Calibrated sleeve or threaded sleeve)
7) Machine a sleeve
8) Fit the parts to YOUR machine.

The first and easiest place to put bearings is between the pinion gear and the end of the threaded sleeve. There is one and only one bearing which will fit here. It is manufactured by Boston Gear and is available through MSC (and others).
3/8 ID
11/16 OD
9/32 Thickness
MSC #: 03548591
Page 3689 on the "Big Book"
Boston Gear part # 17195
Price $9.24 ea (08/14/2010)

You will need one of these. The other bearing I will use is an INA to lower cinversion cost. If you wanted to, however, you could use two of the more expensive bearings.

The second bearing is a roller bearing. Here you must buy three parts, the bearing and two ground washers.

The bearing has:
3/8 ID
0.813 OD
0.078 thiskness
MSC #: 03380896
Page 3692 in the "Big Book"
INA part # TC613
Price $2.87

The washers are"
3/8 ID
0.812 OH
0.032 thickness
MSC #: 03381068
Page 3692 in the "Big Book"
INA Part # TW613
Price $0.91

Installing the second bearing requires some machining.

To install the Boston Gear Ball bearing, you will need to face off EITHER the back of the pinion gear of the front of the threaded sleeve or both. I had done part of this conversion some years ago and I think I took the material off the sleeve but I am not sure. If there is room I would take it off the pinion gear. This keeps the bearing forward near the oil hole and may provide better lubrication. When turning down the pinion or sleeve measure the bearing in hand. Subtract the play you initially measured using feeler gages and use this number. The extra length will be used to trim the fit of things later.

NOTE:
All the machining can be done on the lathe to be modified by removing the cross slide assembly, rotating the compound so it is parallel with the cross slide and locking the cross slide gibb.

I encased the outer roller bearing in the calibrated sleeve. I have been told that the grub screw hole on some sleeves may not allow this. Before you start this part insure that you have enough room. A new insert sleeve is going to be made that will bear on the bearing on upon which the calibrated sleeve will rest. Some trimming of the length will be necessary. I am including a print BUT this is for reference only. You must CAREFULLY measure YOUR parts to get the lengths correct.

First we need to bore the calibrated sleeve for the thrust bearing and also open the 3/8 bore up to ½. The dial sleeve is 1 ¼". Its too big for a standard collet so I chose to mount it in my 4 jaw chuck. Figure 2 shows the set up.

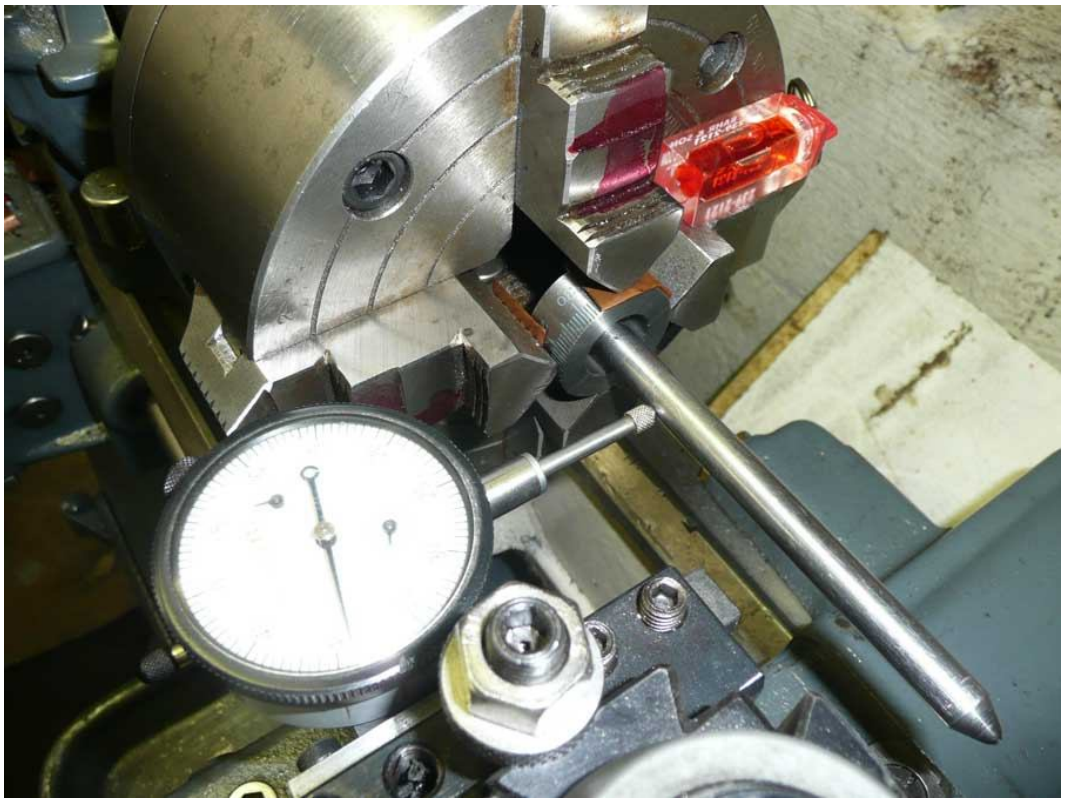

Figure 3 Setting up to Bore for the Roller Thrust Bearing.

Note that there are pieces of soft copper under the jaws to prevent marking the dial I have put a tight fitting shaft into the bore and I will be indicating against the shaft. I am using a QC mounted DI. Also note the small level on the far jaw of the chuck. Whenever I am truing on the 4 jaw I use this. It was a freebee at the local hardware store some years ago. By setting it level I an assured of always getting back to the same spot. This is particularly useful when you are quite for off center (just starting) and using a small diameter rod. With just three tries I had a TIR of less than 0.002. Now with the dial centered the first step is to open up the bore to ½"
Starting with a 7/16 drill and then going to 15/32, 31/64 and finally ½" I drilled through, opening the existing 3/8 hole. Note that I am using short cobalt screw machine drills. These are short, stouter and have less bending. Thus they are more likely to be accurate. The hole will come out undersize when you approach it in this manner, which is common with drills used in this fashion. You just need to know what the bore is when you make the new internal sleeve.
If you have a 12.5 mm drill I would recommend using that just before the 1/2 " drill.

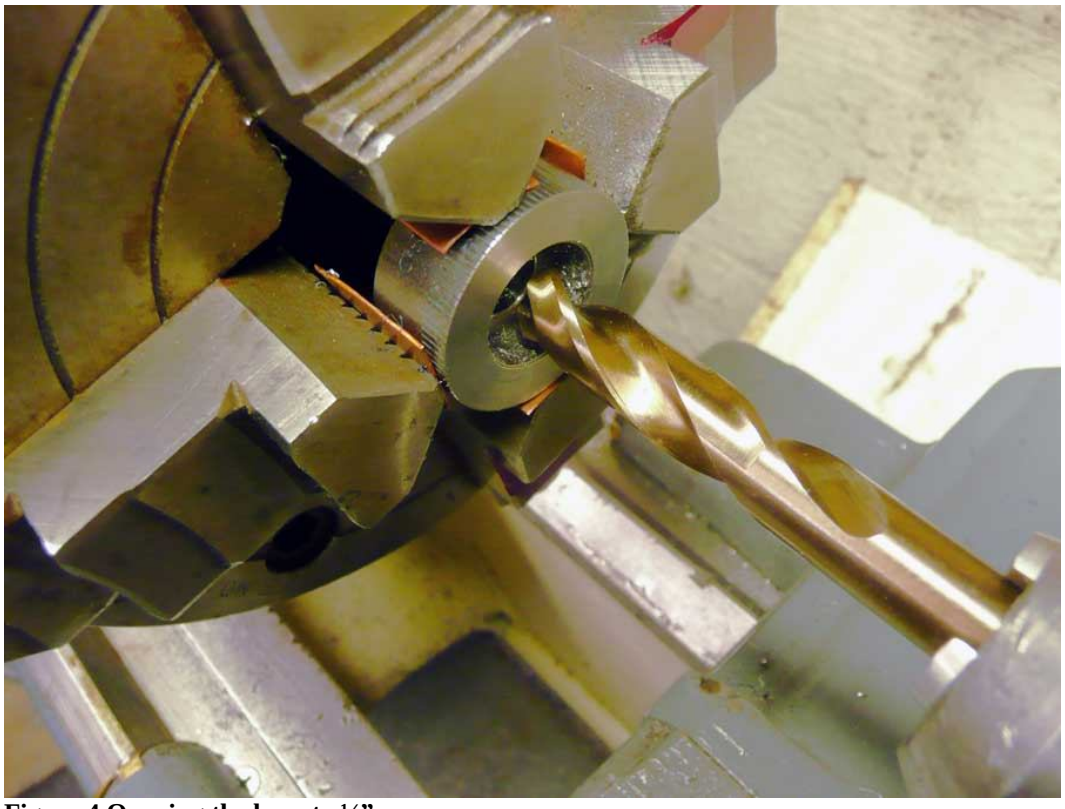

Figure 4 Opening the bore to ½"

Next a step 0.815" in diameter and 0.211" deep was opened. If you have one of the calibrated dials where the grub screw breaks into the counter bore you will nee to put this step into the threaded sleeve. In this conversion you must always be aware that the final tuning of the lengths is critical. The assembly can be tuned in many ways and the

numbers I am providing are targets for MY assembly ONLY. Your lathe and assembly WILL, most likely, differ.
FIRST MEASURE EVERYTHING IN SITE.

The 0.211 is critical but it can be compensated for by the new sleeve. I arrived at the 0.211 number in the following way.
The bearings with the two washers measured 0.141.
I targeted to make the flange on the sleeve 0.066 wide.
That's a total of 0.207.
You don't want the calibrated sleeve to rub against the end of the threaded sleeve.
The 0.211 number leaves a gap, between the far end of the calibrated sleeve and the face of the threaded sleeve of 0.005. If you miss your number you can make the NEW sleeve flange thicker or face a bit off the calibrated sleeve. (Easier to make the flange thicker).
If you are putting the bore in the threaded sleeve this 0.211 also works.

The boring operation can be seen in the next figure. You may be noticing an existing lager bore in the piece. I had once buried a second Boston Gear bearing in this screw assembly. I later used one of the bearings on another lathe. However in the initial fix I never added the additional sleeve. Since I had the INA bearings on the shelf I decided to use them and the bore needed to be opened.

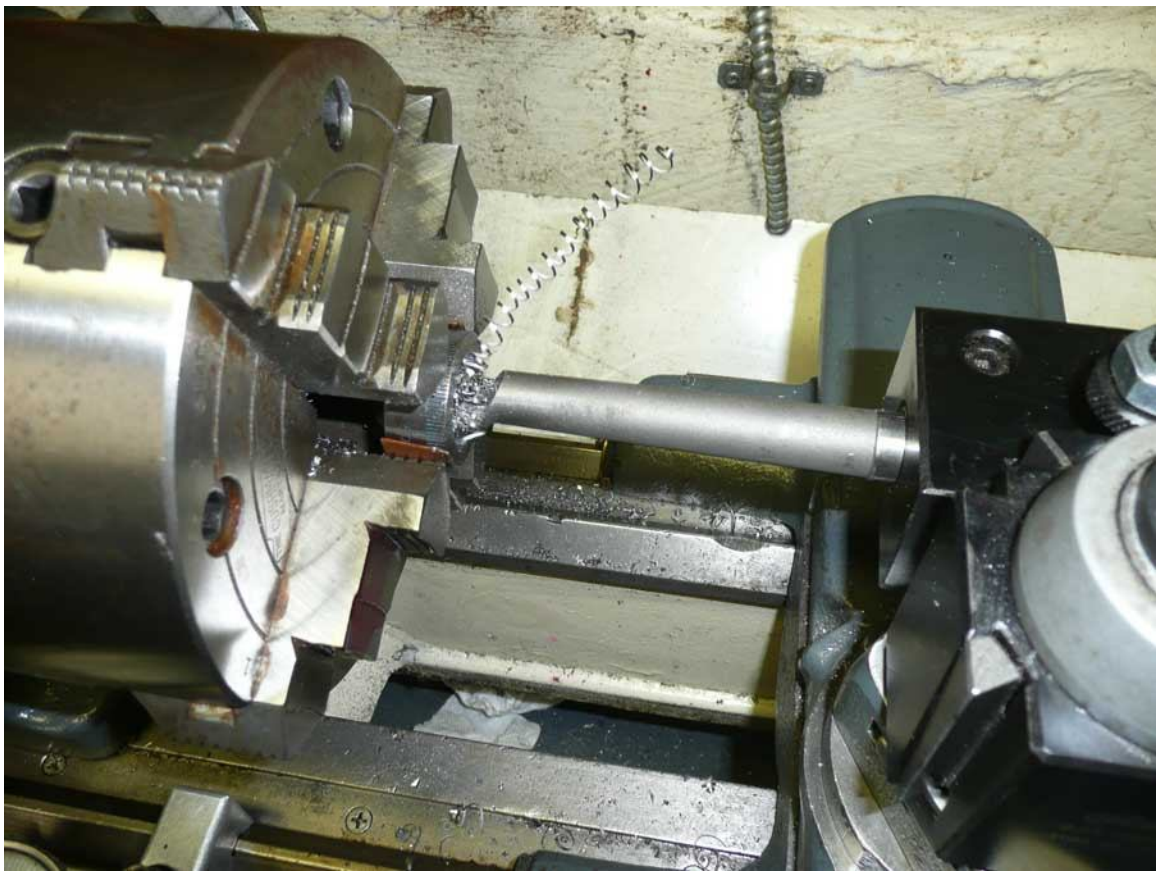

Figure 5 Boring the Calibrated Sleeve to 0.815" diameter by 0.211 deep.

After deburing the Calibrated Sleeve this finishes work on this part of the project.

Note:
I converted my Heavy 10 to large dials a year or two ago. I have had the small dial assembly sitting in my tool box since then. I am doing this conversion ONLY to show it can be done.

Next you will make a new sleeve. This does not exist on the assembly. I used a piece of 1" 1144. If you have 7/8 that's fine, 1144 is not a necessity, HRS or CRS will work just fine as will drill rod also.

I switched from the 4-jaw to a collet. If you don't have collets or a 1" collet, then leave the 4-Jaw there.

I start by turning to 0.812" diameter for a distance of 1". I am using a 2" dial indicator stop on my lathe. After facing off the end I set the indicator to 0. Measuring the 1" distance is then easy. 7/8" would have been adequate. (Figure 6)

Figure 6 Starting the Inner sleeve; turning to 0.812

I then drilled and reamed to 0.376. You need to have a hole between 0.003 and 0.005 smaller than the 376 reamer for it to cut properly. You should use a letter U or a 9.4 mm drill just before the reamer. I forgot and used a 3/8 but using my normal procedure I did cut a bit undersize so the reamer worked fine.

Next you are going to turn to a close fit on the bore you made on the Calibrated Sleeve. Measure this bore carefully and go 0.0005 to 0.001 undersize. My bore measured 0.4975 so I turned to 0.497.

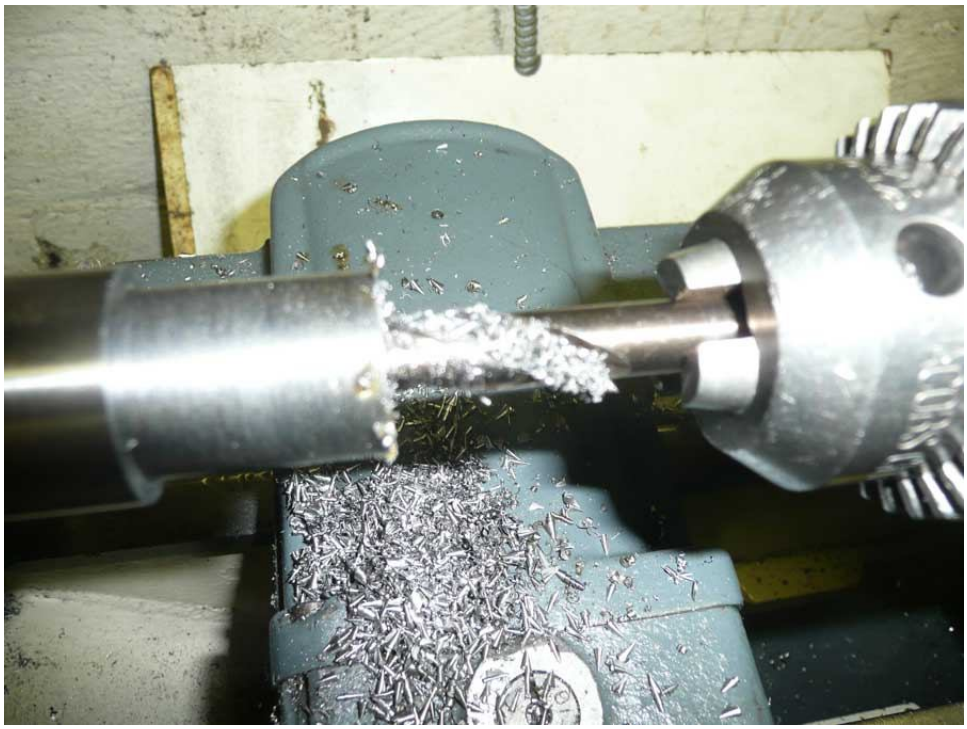

Figure 7 Drill/Ream a 0.376 hole.

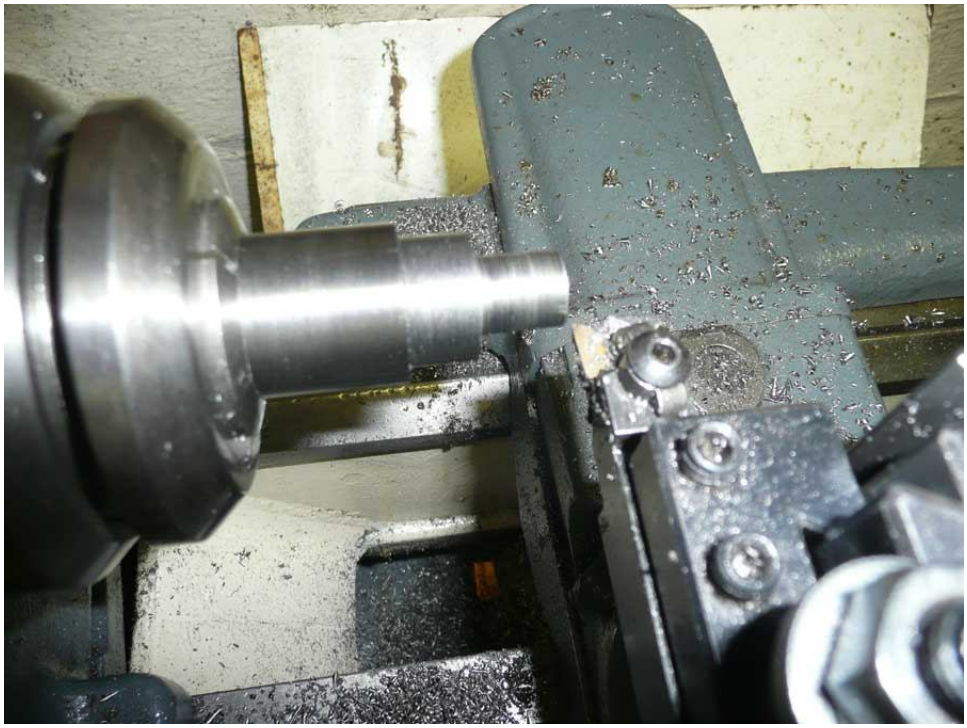

Figure 8 Turning to 0.497 Diameter.

The length of this bore will very with your lathe. Measure the overall thickness of the YOUR calibrated sleeve. Measure the depth of the bearing step you put into the calibrated sleeve. Subtract the two. Add 0.005 and this is you target length.
Mine was. 0.562.
<u>If you are going to put the counter bore in the threaded sleeve your length will be the TOTAL LENGTH of the calibrated dial plus 0.005.</u>

The next steps are to part off the sleeve and trim the flange to the proper thickness.
I had planned to make my flange 0.066' thick. I have never had much luck with parting resulting in a nice straight wall. I thus parted the thickness oversize 3/32 and I planned to face off the flange afterward to the proper thickness.

Ever since I change my drive belt over to a serpentine belt parting has gone well. Figure 9 shows the process part of the way through. In Figure 10 I trim down the excess flange width to 0.066.

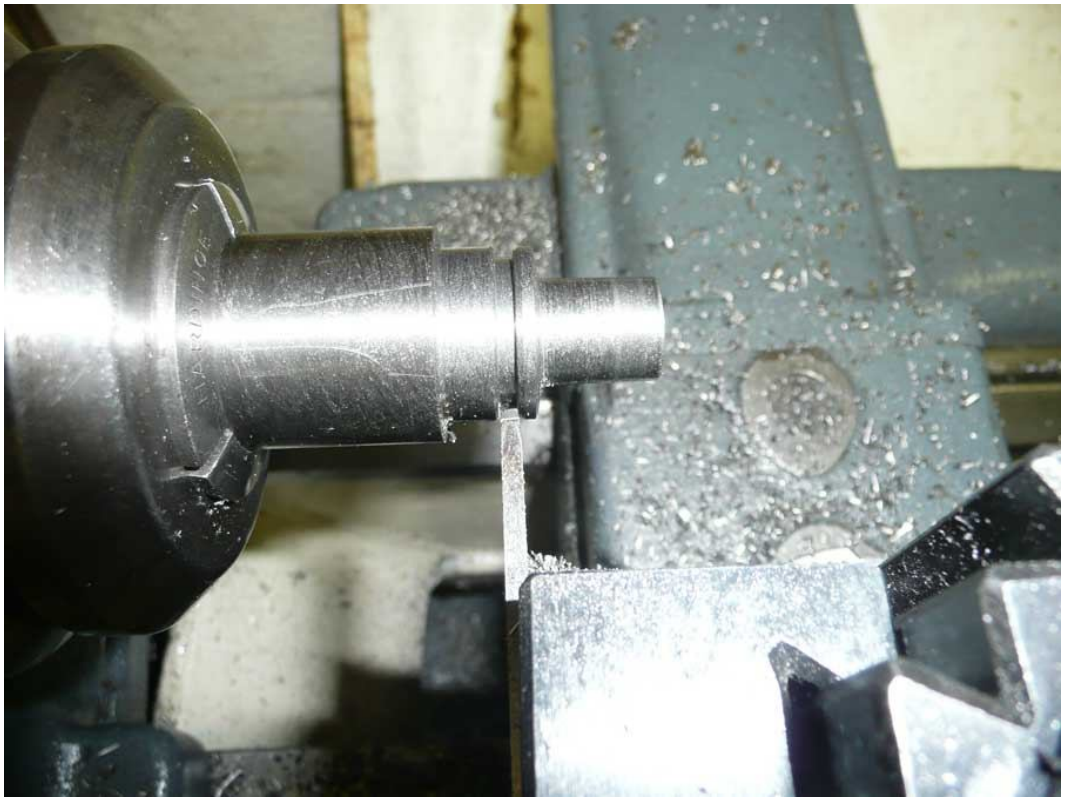

Figure 9 Parting off the New Inner Sleeve

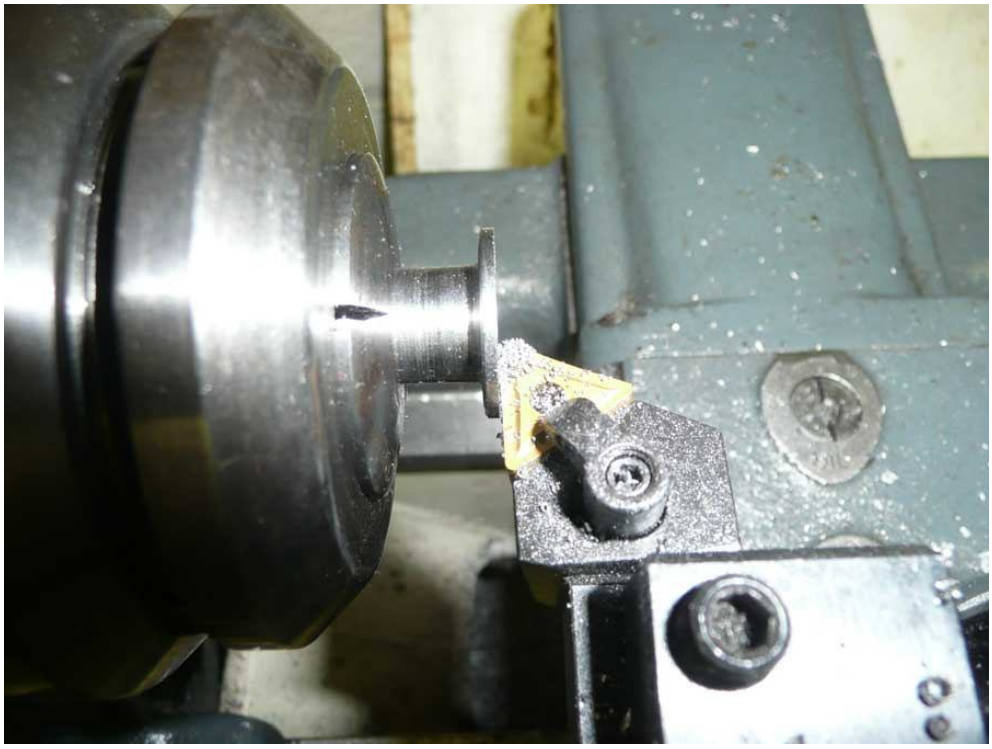

Figure 10 Trimming the Inner Sleeve Flange to 0.066”

My tool has a strong (1/32) radius. I need to do something to accommodate that radius or the Dial will hang up on the sleeve. I could put a chamfer on the bearing bore in the calibrated sleeve or I could remove the radius with a sharp tool. I chose the latter, because I have such a tool.

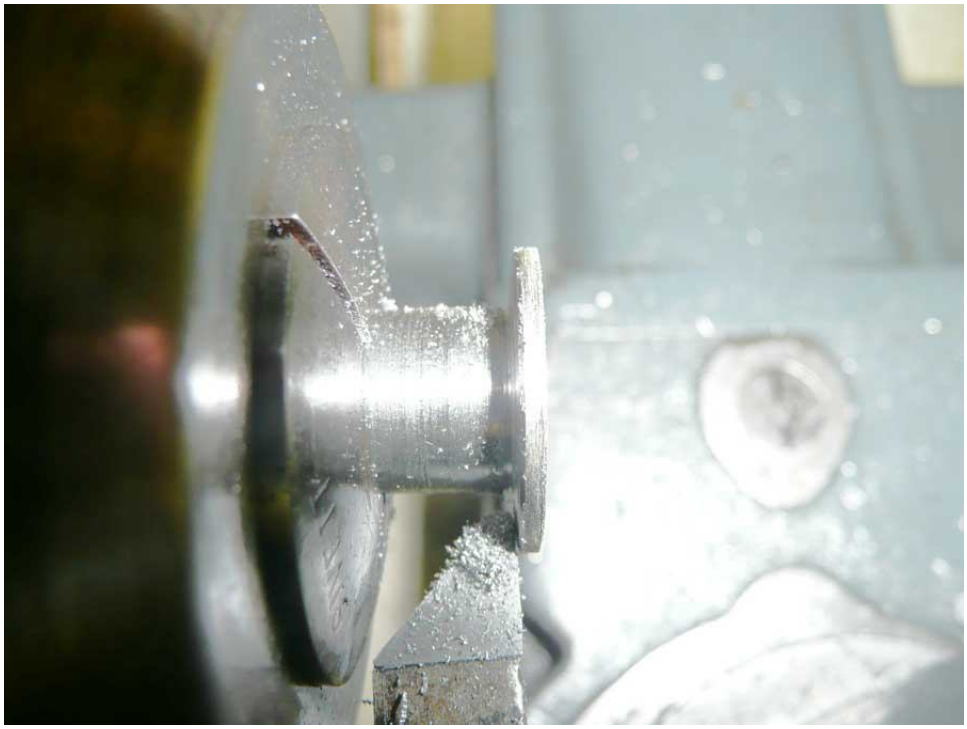

Figure 11 Removing the Flange Radius.

Here the sleeve is held in a ½" collet and the radius carefully removed. The part is then deburred and tested for fit both on the shaft and in the calibrated sleeve.

You are now ready for assembly and fitting. This may take several tries to get things just right.

You need to have the handwheel just butt against the step on the shaft as it preloads the bearings with about 0.002" of crush.

When assembled and pushing the calibrated dial against both bearings the inner sleeve should be between 0.002 and 0.005" proud of the calibrated dial and about 0.002" proud of the step on the shaft.
If the inner sleeve is not proud of the calibrated dial the best fix is to take a few thousands off the face of the dial. If the sleeve is not proud of the step turn the step back, just enough.
If the sleeve is too proud, which will result in the bearings binding, turn the sleeve down. To do this, I Superglue a 3/8 shaft into the bore of the sleeve, leaving the sleeve just a bit proud of the shaft. Let it cure for at least an hour. I usually do it over night, and carefully turn it back. When finished a sharp blow on the shaft while holding the sleeve back will free the shaft. Clean up the bore with Acetone and a ½" drill by hand.

If the preload is not enough the sleeve sill not turn with the handwheel and the calibrated dial will loose its reference. It takes a bit of trying to get everything right.

Some people set the preload up without the calibrated dial in place and cross drill and pin the sleeve in place. Apparently South Bend also did this on the 10K, at least. This is a one shot approach and if you don't get it right the first time you may not have a second time. Another approach is to set the preload and use Locktite to hold the inner sleeve in place.

I have done three of these (two were SB-9" workshop lathes) and have been able to get things right each time. I know that Dennis Turk uses the pin approach however. If you set the preload and pin the sleeve then the handwheel bears against the sleeve and there is no criticality to the length of the sleeve.

Conclusion

I have detailed, how to convert the Small Dial Southbend Heavy 10 to a ball/roller bearing mounted unit. This eliminates axial play for now and for the future. It is a modification that Southbend incorporated in the Large dial options.

In addition this VASTLY improves the "feel" of the lathe when cutting.

Figure 12 The Finished conversion.

Figure 12 shows the entire converted assembly. The Boston Bearings are visible just behind the pinion gear. The INA bearings, however, are completely imbedded in the calibrated dial and well protected. The downside is that either periodically you should remember to put oil in the slight gap, between the calibrated dial and the threaded sleeve or you should drill an oil hole in the threaded sleeve.

Jim B. 08/15/2010.