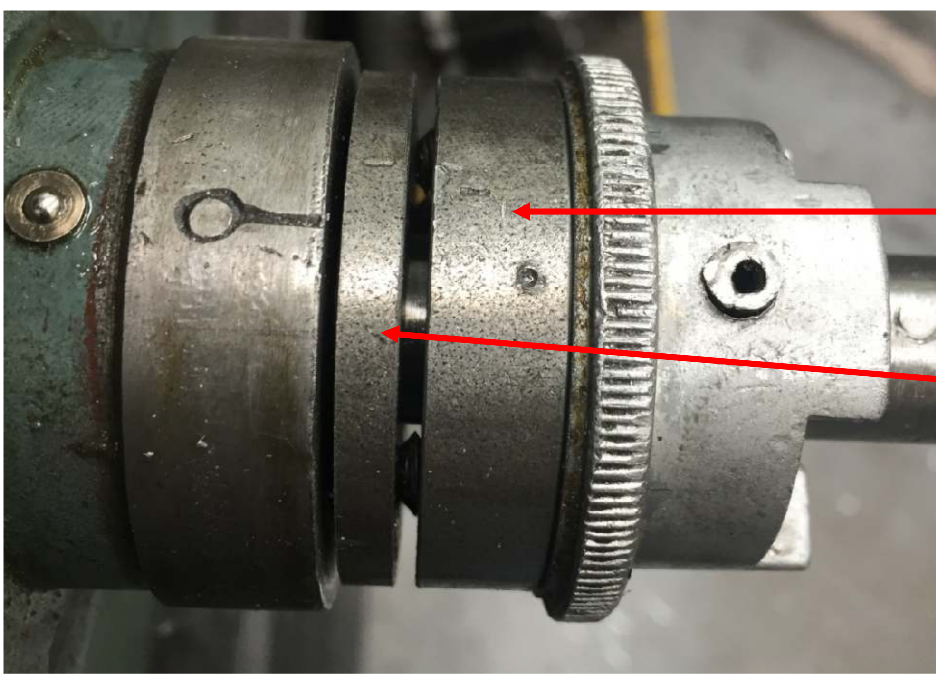
A Variable Thickness Washer for Preloading a RF-30 Mill/Drill Leadscrew Bearings, version 2

By R. G. Sparber

One source of backlash and change in backlash as a function of table position on a RF-30 Mill/Drill is the play in the bearings[2]. Adding shims certainly helped but it was difficult to get exactly the right thickness and also be able to drive the locking spring pin through the drive spline.

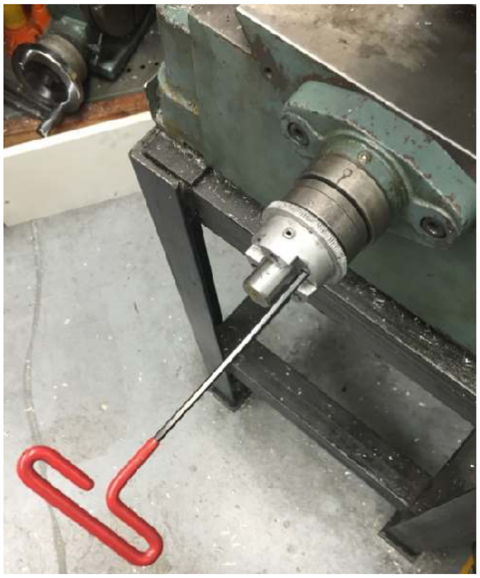
What I really wanted was a variable thickness washer that could be easily set while in place.



Well, here it is. The washer consists of two parts.

The thicker collar contains four set screws. These screws push on a thinner washer which in turn applies pressure on the bearings.

[1] You are free to distribute this article but not to change it.
[2] See http://rick.sparber.org/XYBR.pdf for background.



Access to the set screws is through the drive spline.

Alignment is done off of the mill.

The leadscrew is held in a precision V block. The bearing block is in full contact with the face of the V block. The four set screws are first lightly tightened while verifying the bearing block is still square to the V block. Then all screws are snugged up. The leadscrew is turned to verify the bearings are tight but not binding.

Assessment

There are two reasons to pretension the thrust bearings. First, it reduces backlash because the leadscrew is not sliding in the bearings. Second, it reduces the change in backlash which is a function of table position along the axis. An article explaining this problem will be out soon.

The best way I have found to assess the pretensioning is to directly measure the change in backlash. When I was using shims, the change in backlash was about 1.5 thou over a 3 inch movement of the table along the Y axis. With pretensioning, it was a tenth.

Here are the Players

the outer bearing surface which directly contacts the outer ball race

fabricated driven collar

fabricated driving collar with four set screw

fabricated alignment cylinder used during match drilling process

modified drive spline

Two of the set screws are aligned with spline lands. It was tempting to place a third set screw in the third spline land. But this would have prevented me from adjusting it when the spring pin was installed. So instead I went with two more set screws that avoided the spring pin.

This project is not without a little drama. To make room for the variable thickness washer, I had to modify the drive spline. Since replacement parts are most likely unavailable, modifications are difficult to undo.

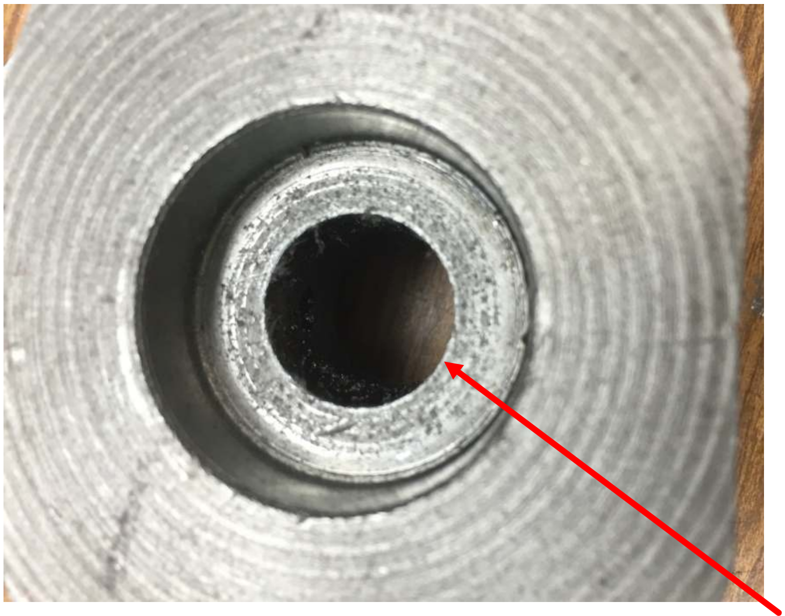
The driven spline seems to be made from a cast zinc-aluminum alloy. Holes are cast into the spline lands that go in about 0.2 inches.

The section below the knurled ring was sawed off. Then the part chucked into my lathe and the face trued up.

Originally, a steel tapered insert was fitted to the inside of the drive spline. The face shown here is proud by about 10 thou. This subtle feature is rather important.
It contact the bearing washer over the ball race while clearing the bearing block face.

I duplicated this feature on the inside face of the driven washer. Since I had the room, I made the ridge 20 thou tall.

Preparation



Before installing the variable thickness washer, I wanted to be sure there were no little surprises in the bearing and bearing block. They could cause the leadscrew to not be square with the inside face of the bearing block and/or cause shifting during the application of pretension.

With the bearing block removed from the mill and both thrust bearings removed, I could feel a burr at the opening to the shaft bore. There was another burr on the other side. These burrs might prevent the thrust bearings from fully contacting the support surfaces. A minute with a small round and curved Swiss file eliminated the burrs.

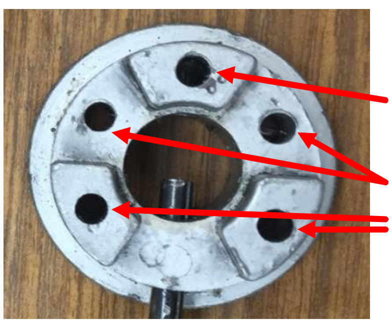
Fabrication

I started with a round piece of 12L14 1-3/4" in diameter. The center was bored out to 0.668 inches to match the bore of the drive spline . You are looking for a sliding fit. The depth was around ¾ inch.

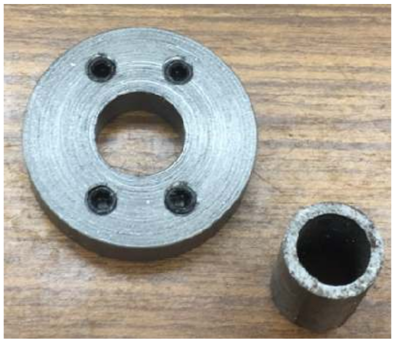
The face was squared up and the 20 thou tall boss turned. Use the existing boss as your guide. Deburr.

Moving to my bandsaw, I cut off about 0.2 inches not counting the boss. Then it was back to the lathe to true up this face. The overall thickness, not counting the boss, was around 0.17 inches. Deburr.

The round stock was again chucked into my lathe and the end trued up. Then it was back to the bandsaw to cut off a piece 0.4 inches long. Return to the lathe to true up this face. Deburr.



Select a drill that is a sliding fit to one of the cast holes. Using a drill press or your mill/drill, drill two holes centered on the small cast features plus drill out the holes in the spline lands.



I found a piece of gas pipe that almost fit through the bore. It was turned down to a sliding fit and used to align the drive spline and drive collar. I punched a small feature into the outside diameter of the drive collar to line up with a punch mark on the drive spline. This was helpful during installation. Offset the punch marks so the correct face of the drive collar is forward.

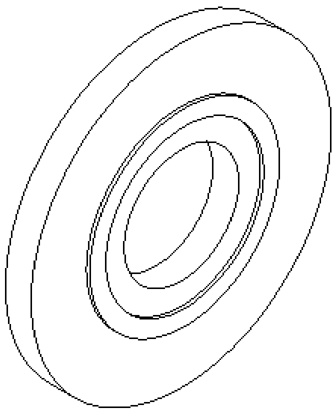
With the spline collar, drive collar, and alignment cylinder securely clamped together, I match drilled through all four holes just enough to cut a cone into the face of the drive collar.

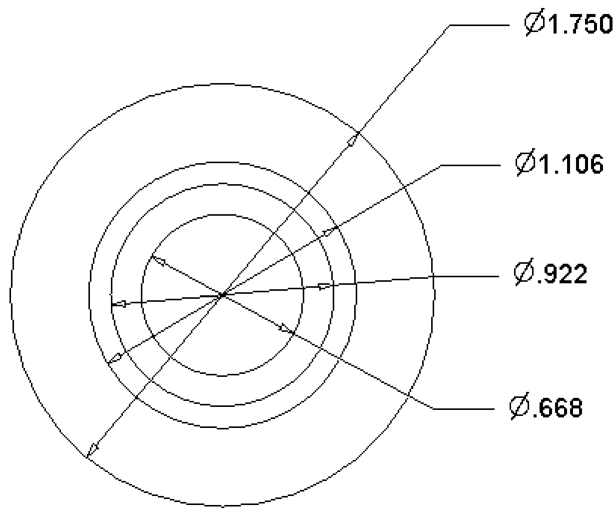
Then the drive collar was removed and I used a #7 drill to drill through the drive collar in four places. These holes were then tapped ¼-20.

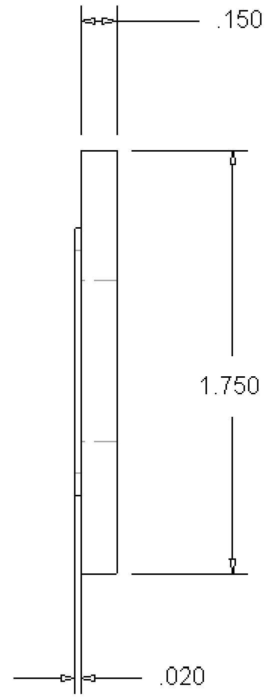
Four ¼-20 set screws 3/8" long were installed.

It is important that all collar faces are square but there are no precision machining operations.

Driven Washer
CRS or 12L14

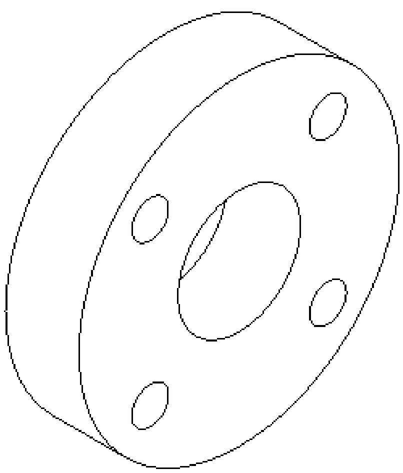


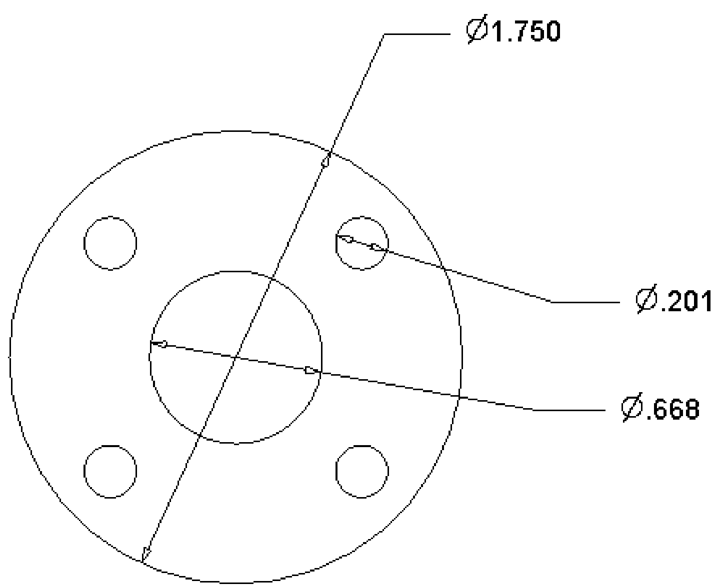




Driving Collar

material: CRS or 12L14
D & T 1/4-20 (4) match drilled from coupler
0.400" thick





Acknowledgement

Thanks to Peter Bready for catching an error in dimensioning.

I welcome your comments and questions.

If you wish to be contacted each time I publish an article, email me with just "Article Alias" in the subject line.

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