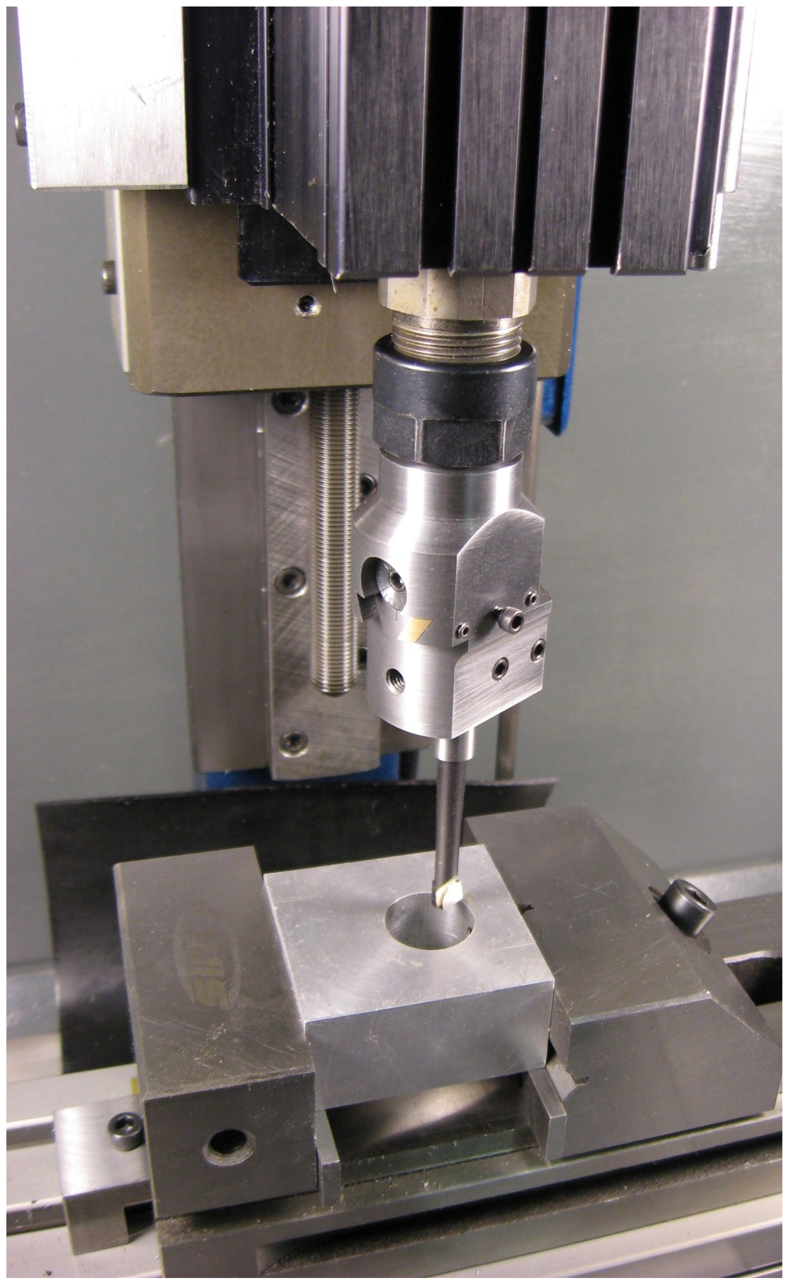
A Small Boring Head for the Taig Mill

by Keith Brooke

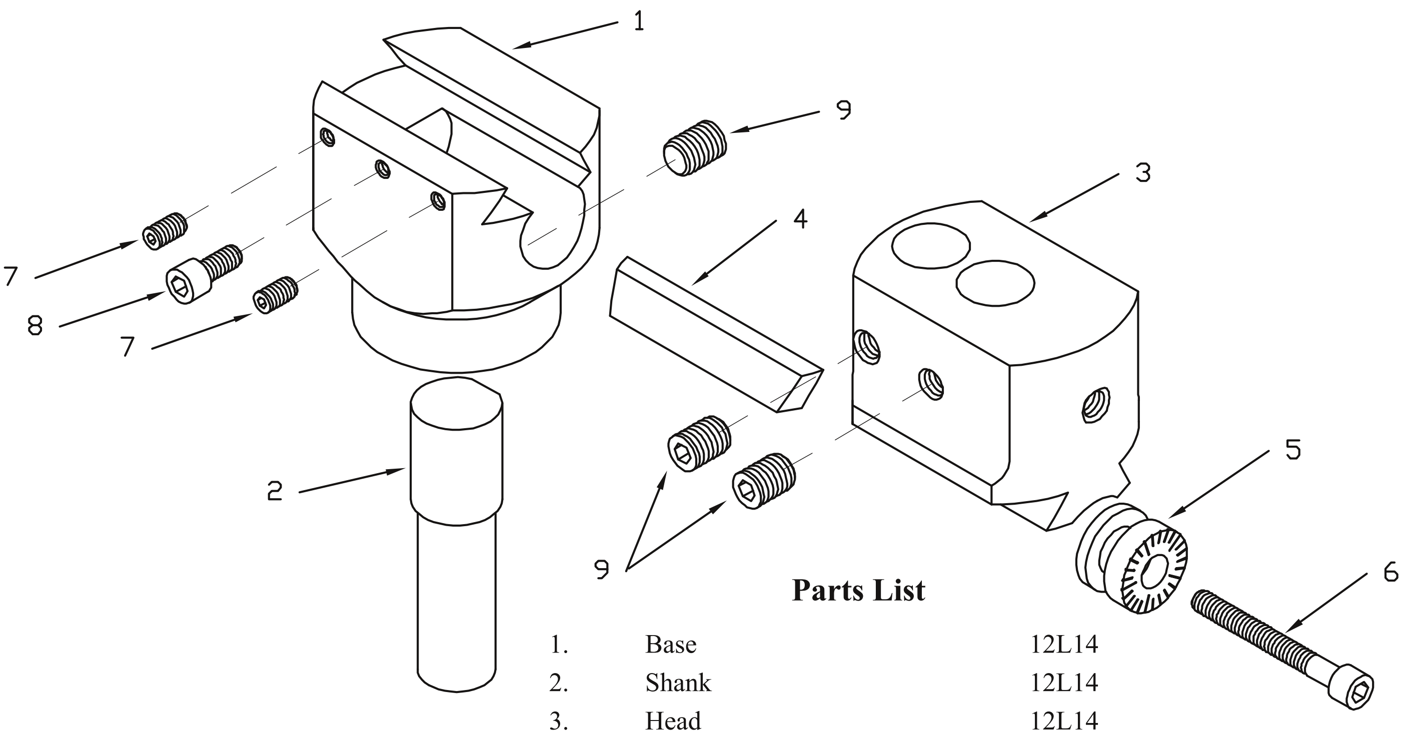
May, 2009

For a light mill like the Taig, a primary consideration in a boring head is imbalance causing vibration and chatter. The smaller the initial diameter, the smaller the head mass, possible offset and resulting imbalance. The tool shown here is my own adaptation of a very common commercial design, but scaled down to the minimum I thought practical for me to make.



The diameter of the head is a compromise involving the dial diameter, dovetail width, gib thickness and set-screw length. Each of these has an optimum but all depend to some extent on each of the others. The current trend seems to be toward the use of a saw-slit allowing the female dovetail to tighten without the use of a gib. This makes small diameters easier but requires tight tolerances on the machining of the dovetails and the tapping of really short blind holes.

Ultimately, it's a judgement call and I decided the gib approach provided a little safety for a first-time dovetailer and a 1 3/8" diameter was an acceptable compromise with less than half the head mass of the common 2" variety. It has a 7/16" diameter dial which, with 25 divisions, makes an easily read line separation of almost 1/16". With a 4-40 leadscrew, head advance increments of .001" are indicated and .0005" easily interpolated. A transverse 10-32 tapped hole provides a mounting for any counterbalancing required.

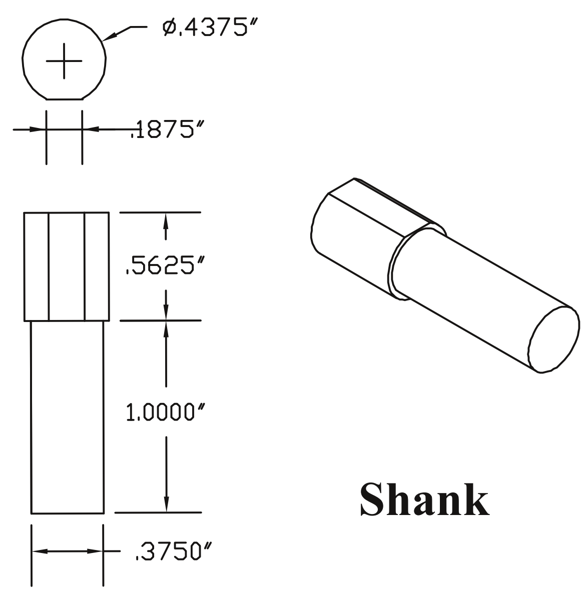


Exploded View

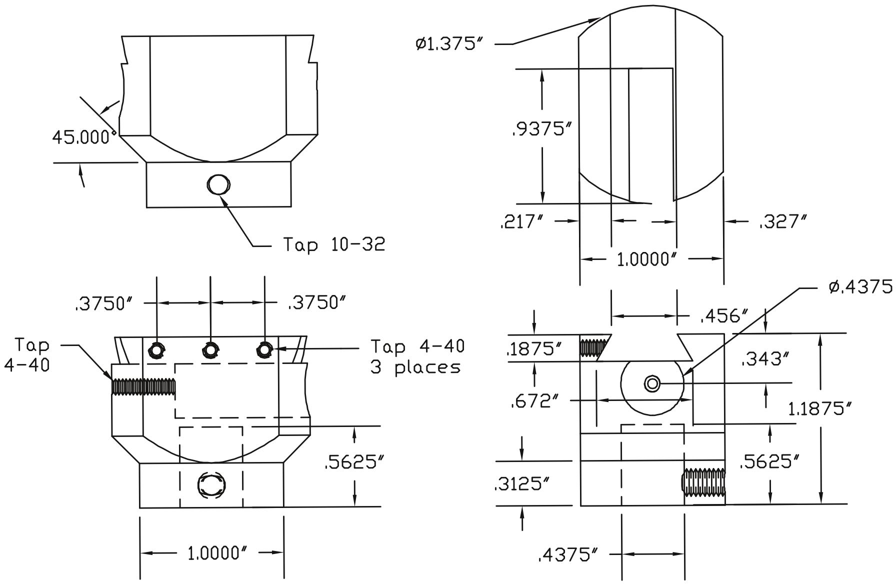
Parts List

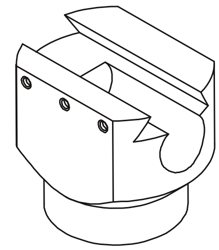
1.	Base	12L14
2.	Shank	12L14
3.	Head	12L14
4.	Gib	Brass
5.	Dial	12L14
6.	Leadscrew	4-40 x 1" SHCS
7.	Gib screw	4-40 x 3/32" SHSS
8.	Head locking screw	4-40 x 1/4" SHCS
9.	Tool and shank set screw	10-32 x 1/4" SHCS

The shank is made first for two reasons. It makes a handy plug gauge while boring its recess in the base and then provides an arbor for subsequent operations. This is a simple turning exercise and needs no elaboration. But be very careful to ensure concentricity of the two shaft diameters. The final product can be no more accurate than the shank.



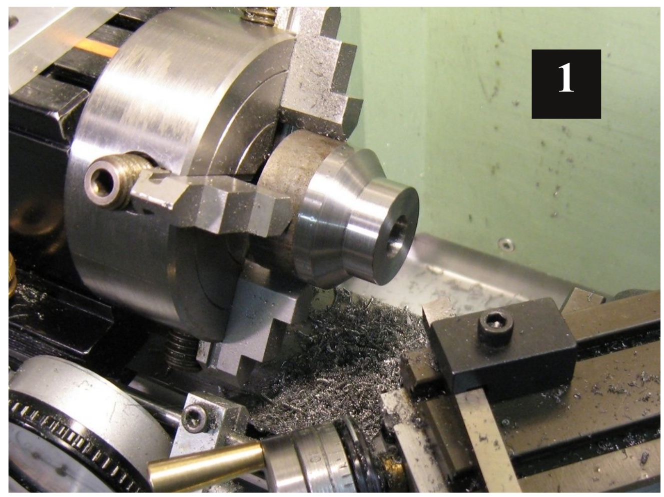
Shank



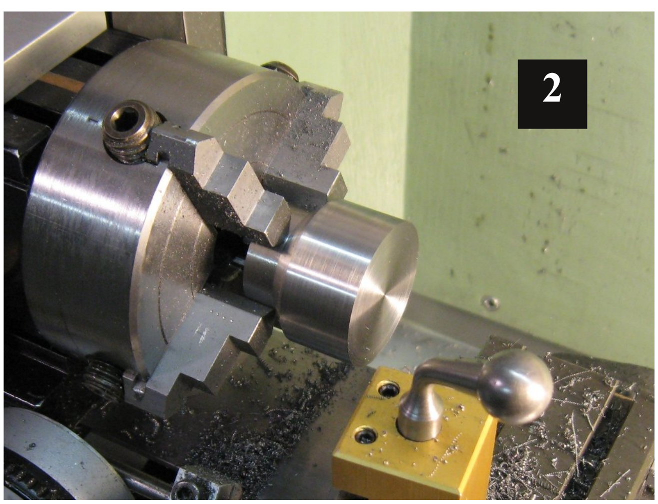


Base

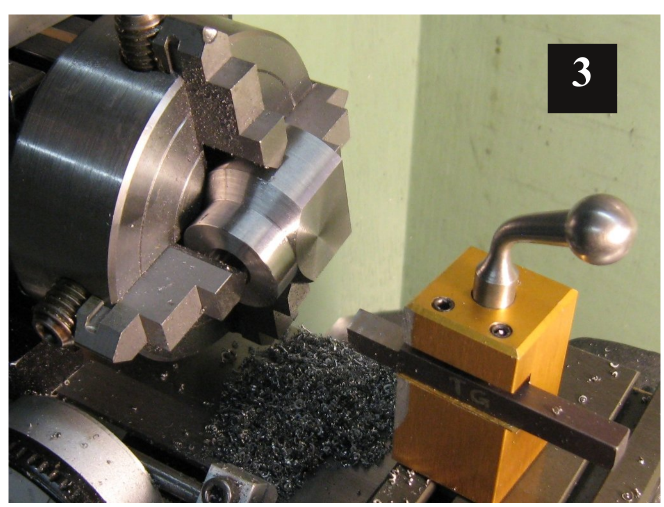
Start the base by centering a 1 1/4" length of 1 7/16" diameter 12L14 in the four-jaw chuck. Skim the diameter just enough to get a true cylinder for 9/16" or more, enough to get beyond the 45 degree chamfer. Don't try to get to 1 3/8" diameter at this point. Final cuts are not made until later when the base and head are joined. Turn the 1" diameter shank housing, drill and bore the shank hole and turn the 45 degree chamfer. Use the shank itself as a gauge to test for the tightest fit you can get that still allows hand disassembly.

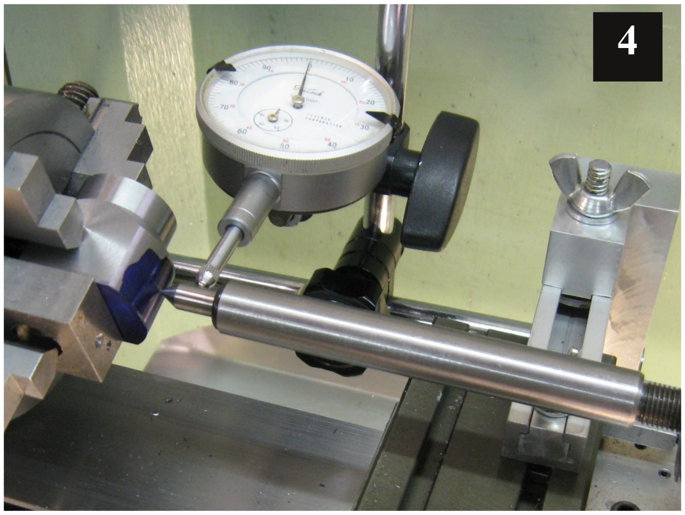


Turn the base around, recenter it in the chuck, finish the outside diameter and trim it to the finished length of 1 3/16". The shank can't be used yet because there is no retaining set screw.

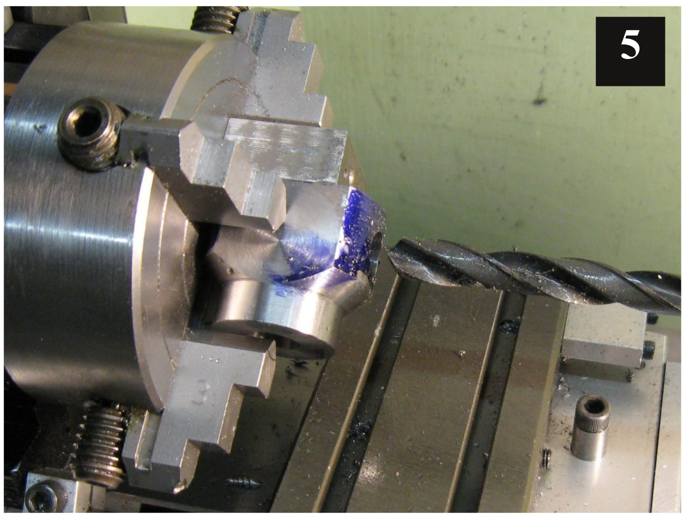


Now the base can be chucked sideways and the flat turned on one side. Measure carefully exactly how much the diameter is reduced in this operation. Turn it around with the first flat against the chuck face and remove exactly the same amount from the other side. Again, don't try to reach the 1" final thickness but leave 1/64" or so on each side for final cleanup.

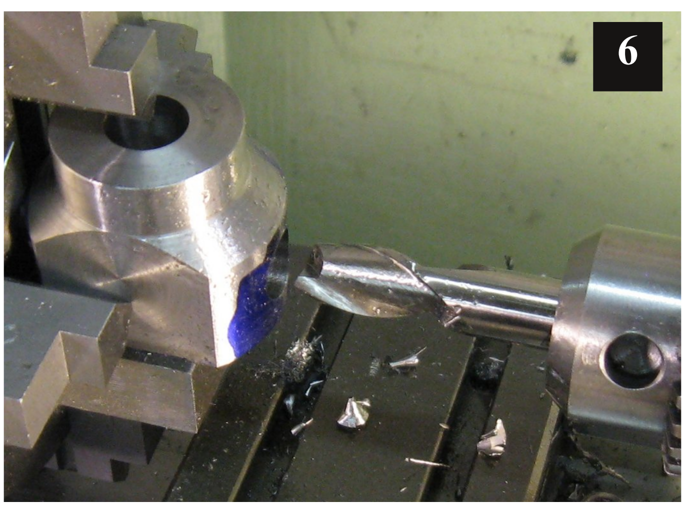




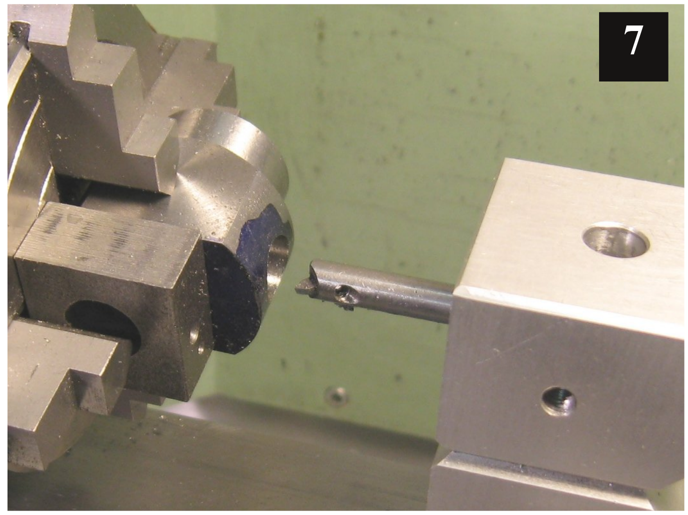
Prick punch the location of the leadscrew hole and center it in the chuck.



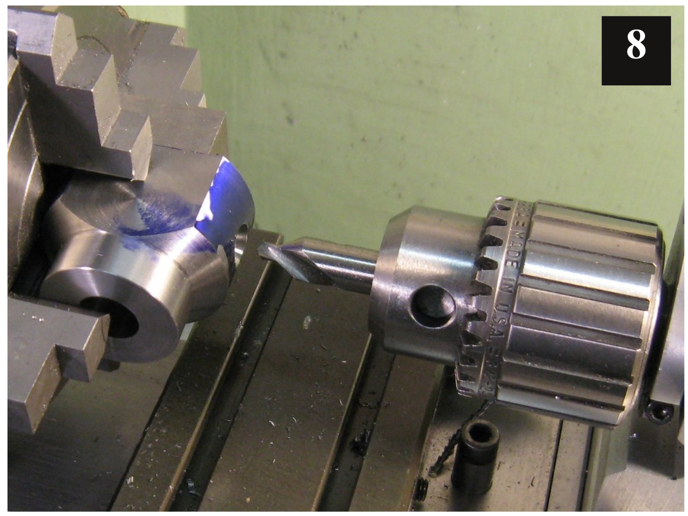
Drill 3/8" diameter 15/16" deep.



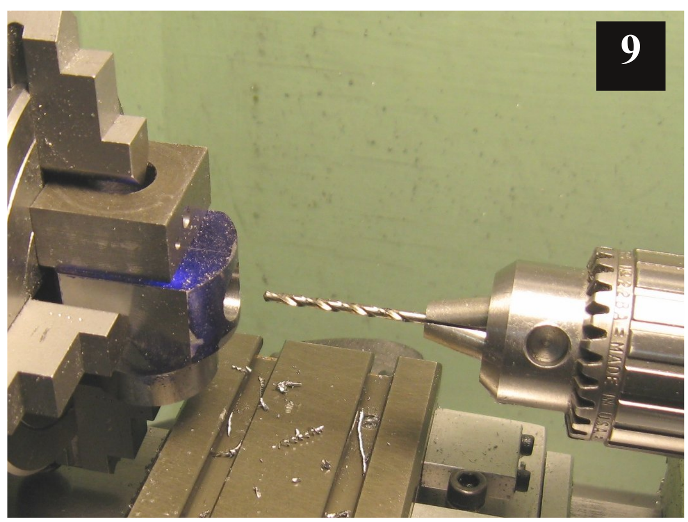
Flatten the bottom of the hole with a 3/8" end mill.



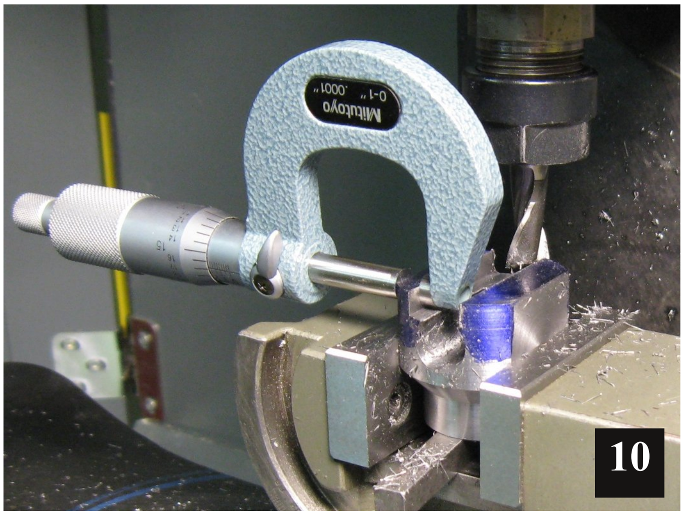
Bore to 7/16" diameter.



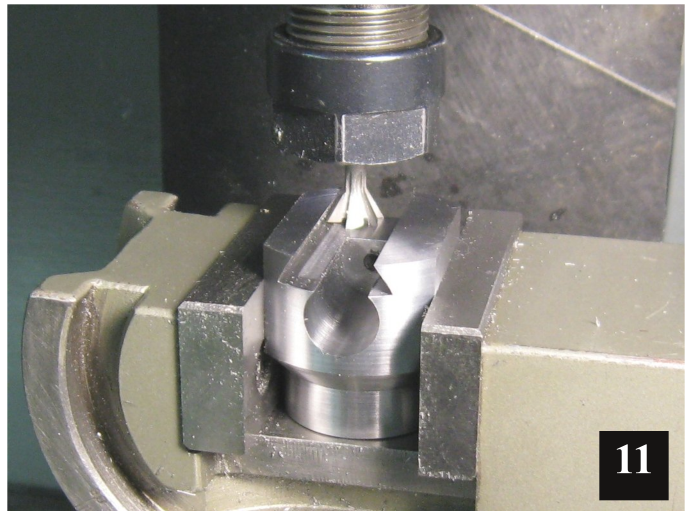
Use a center drill to spot the leadscrew hole.



Drill #43 using repeated short penetrations and chip clearing to keep the hole as straight and true as possible. Tap 4-40.

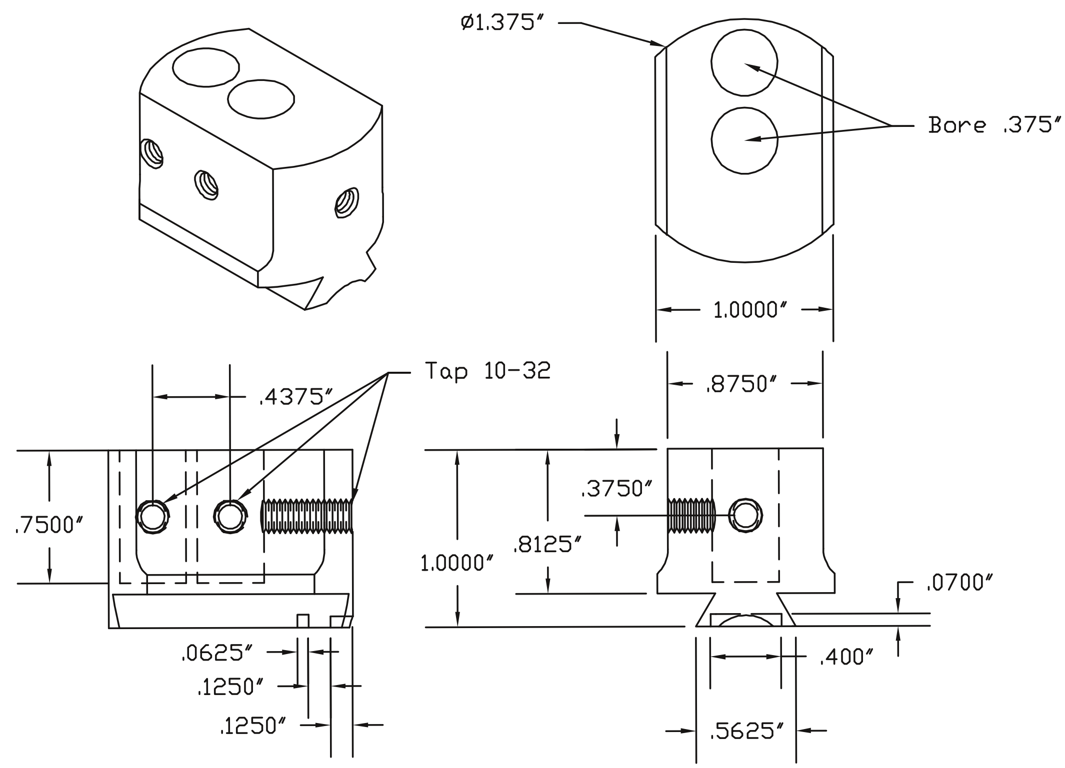


Rough out the dovetail recess with a 3/8" end mill. Work from the initial oversized flat-to-flat width you allowed and calculate how wide should be the remaining shoulders to leave the .456" width recess specified on the plan.. Then careful use of an edge finder, table positioning and a micrometer will let you mill out the waste precisely to the shoulder edges. Leave a few thousands at the bottom to be cleaned up with the next operation.

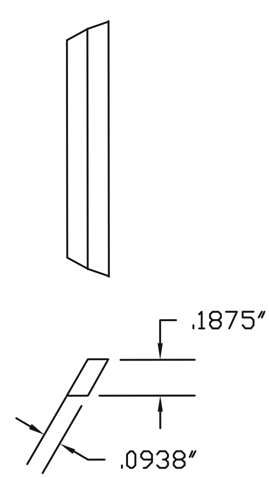


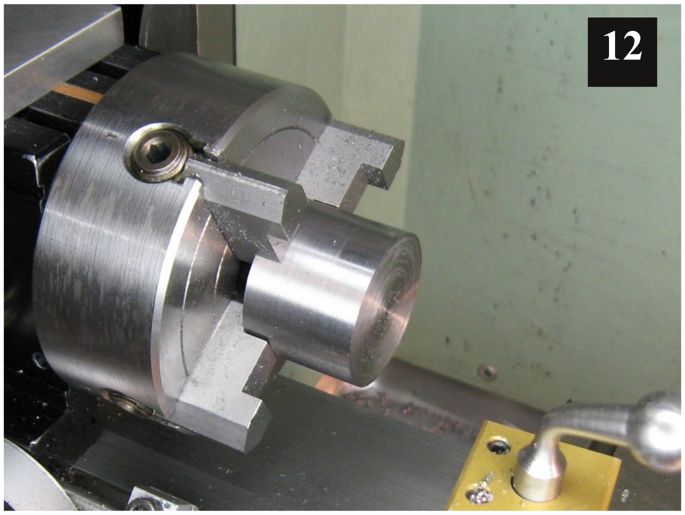
Switch to a 3/8" dovetail cutter. To neutralize any small error in the Y-axis of the mill, vise or work mounting, take a minimum off the top to ensure parallelism with the table travel. Finish the bottom to the 3/16" depth and the sides to the 60 degree bevel. If the dovetail cutter just touches the bottom of the shoulder, milling in exactly .108" should be just right. The advantage of using a gib is the ability later on to compensate for a few thousands error here.

Head

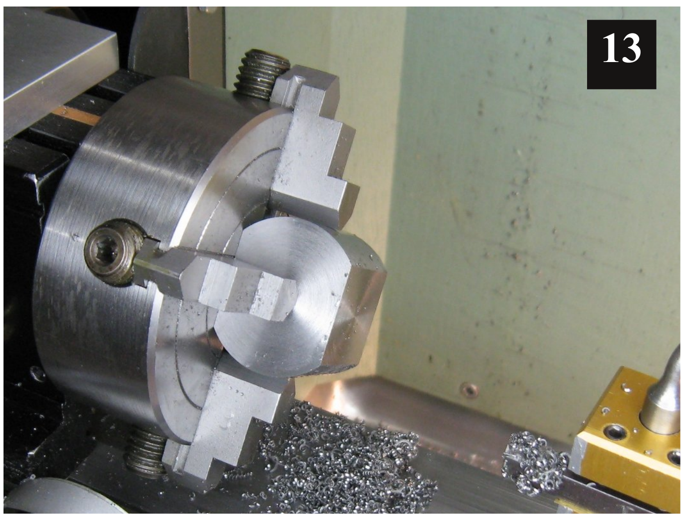


Gib

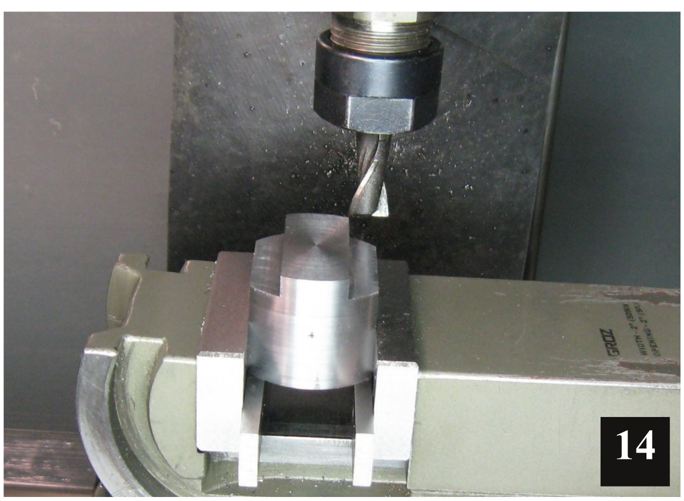




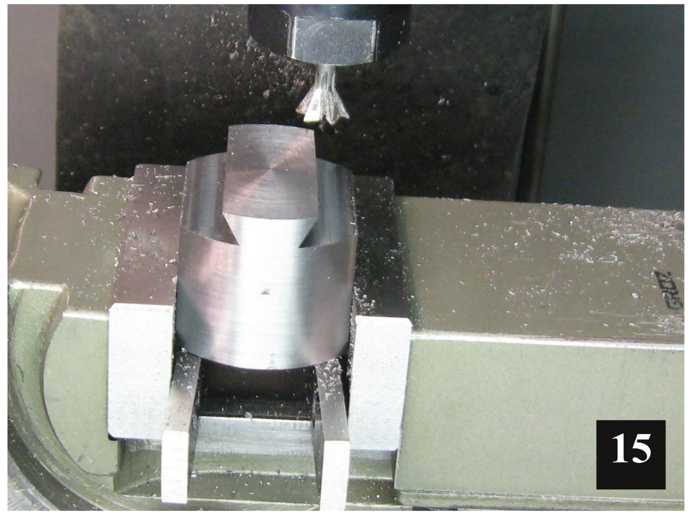
Start the head with a slightly oversize length of 1 7/16" diameter 12L14 and rough it to a 1" long cylinder the same diameter as the base.



Machine the flats to the same size as the base.

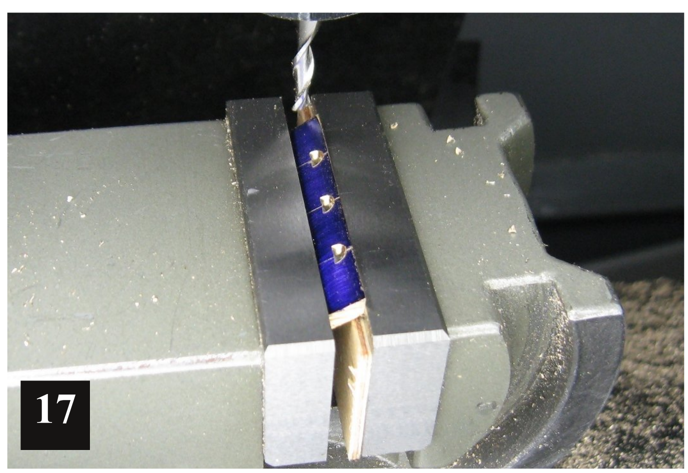


Rough out the dovetails leaving a 9/16" wide center section.

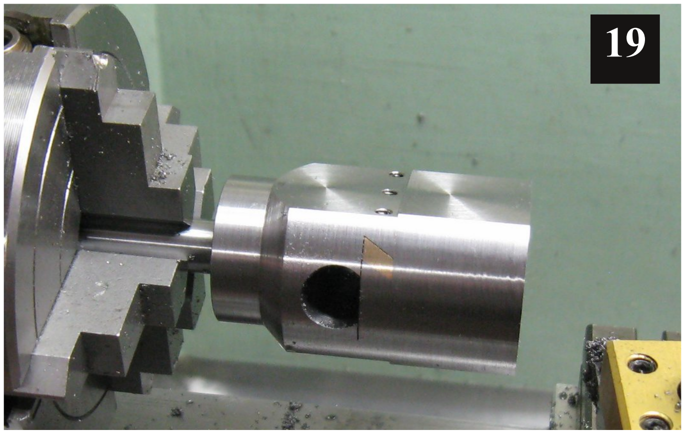


Again, skim the top, cut to depth and mill in .108" to form the dovetails. Check by matching the base to the head while still in the vise.

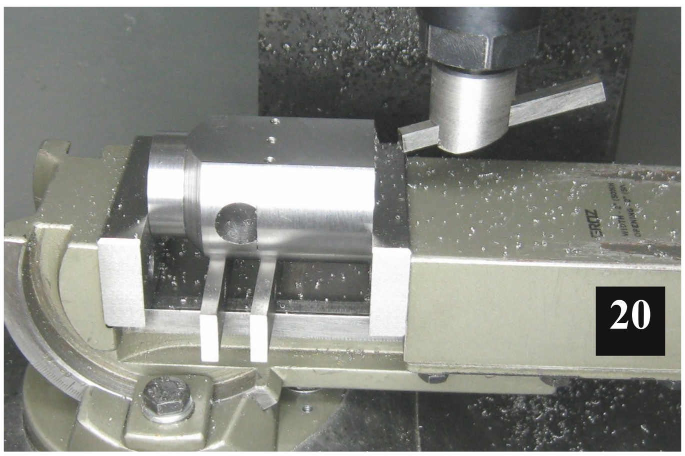
Put the base and head together and measure the gap available for the gib. Start with a 1 1/2" or so length of 1/8" x 1/2" brass and thin it down to fit. Mill the 60 degree angles, reducing the overall height to a few thousands under 3/16".



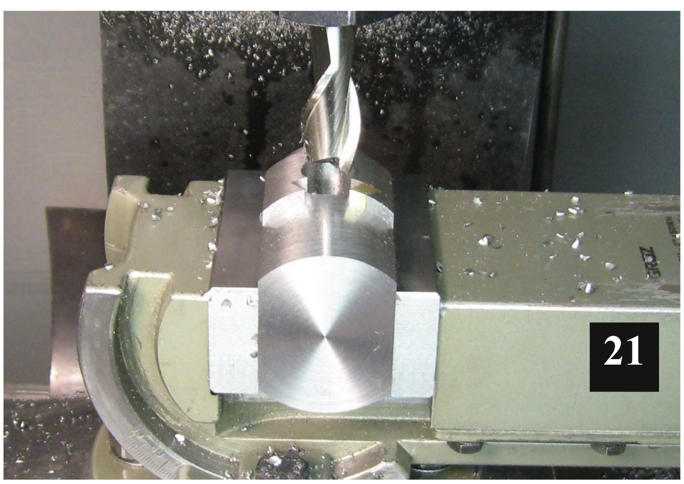
Dimple the gib where the setscrews will go to keep it in place when adjusting the head.



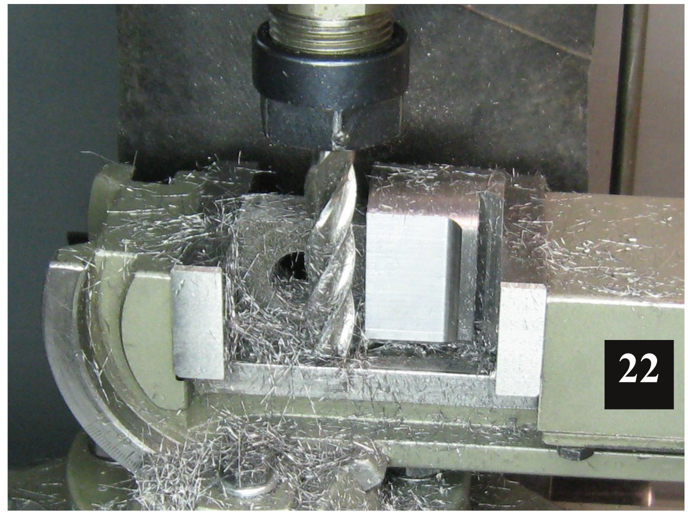
Drill and tap holes for the gib and shank setscrews. Assemble the base, gib and head and lock them together tightly in the concentric position. Chuck the assembly and turn the final 1 3/8" diameter on all parts at once, including the protruding gibs.



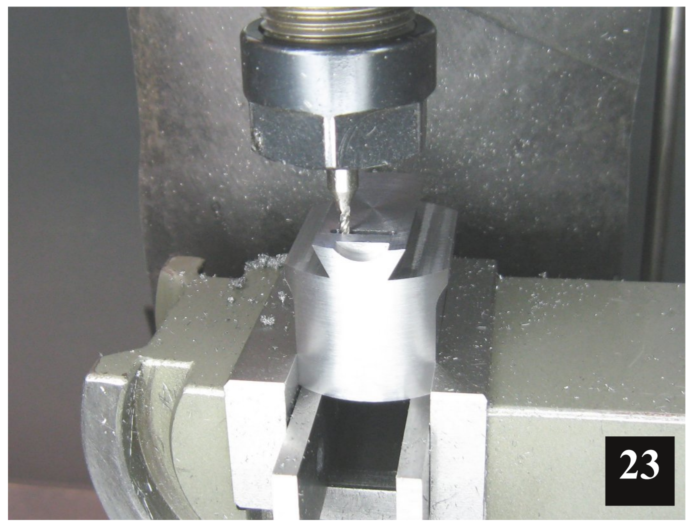
Remove the shank and mill equal amounts off both flats to leave the final 1" body thickness.



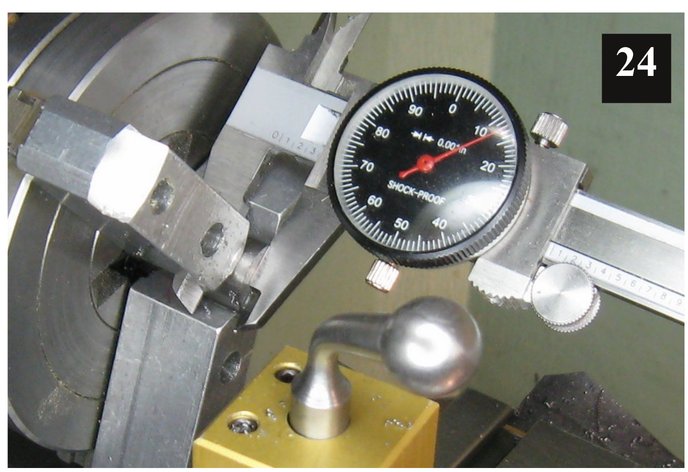
Offset the head enough to center a 7/16" end mill in the leadscrew/dial hole. Bore the head to create a 7/16" diameter segment 1/8" deep.



Remove the head and set it up on the mill to reduce the upper part of the head to the final 7/8" thickness required to provide a flat entry for the outer tool setscrew hole.

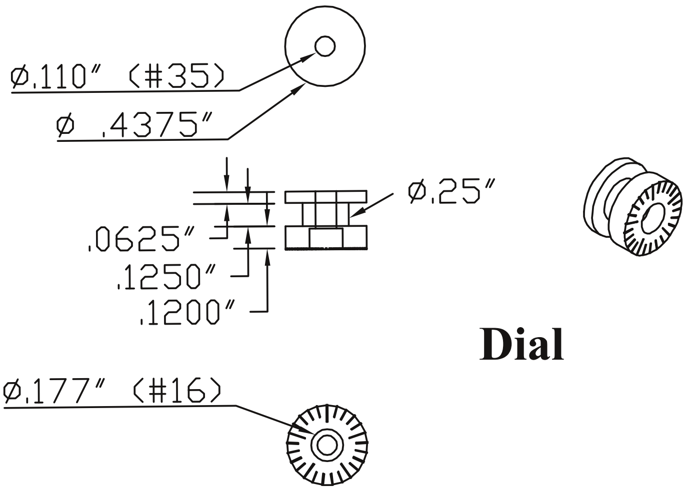


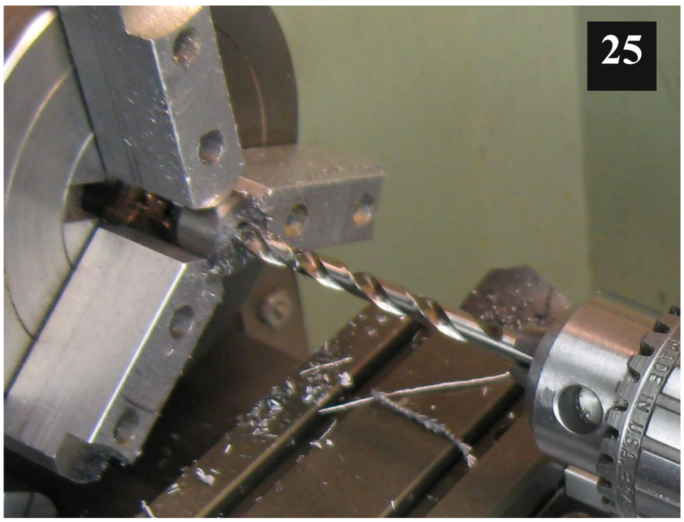
Make the inner dial recess with 1/16" end mill.



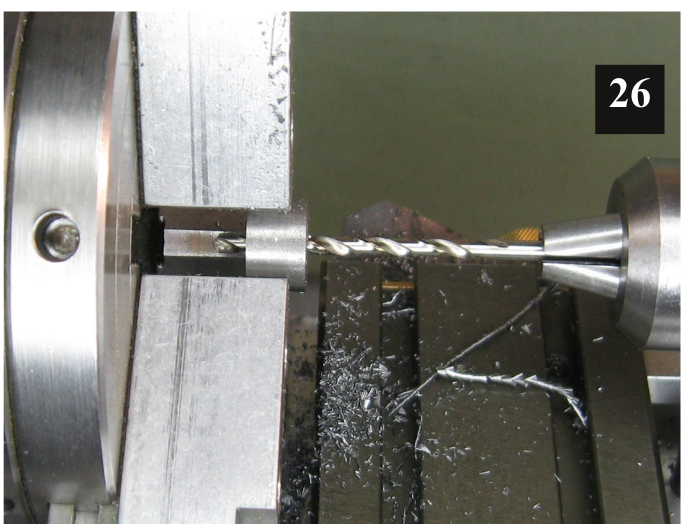
Start the dial by facing a piece of 1/2" diameter 12L14 to 5/16" length.

Dial



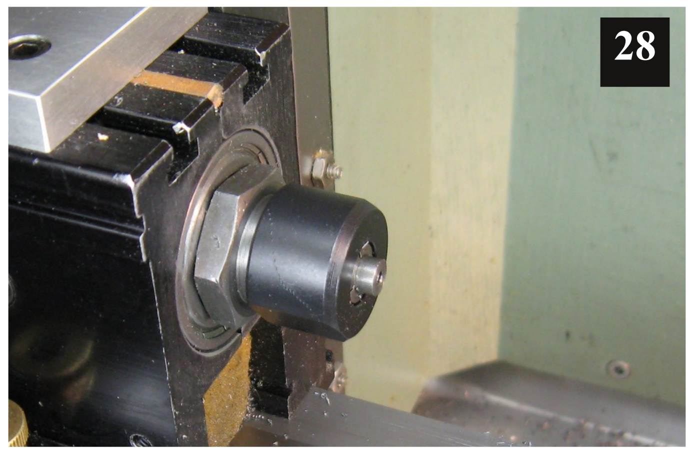


Drill #16 (.177") about .110" deep for a press fit on the head of a 4-40 SHCS.



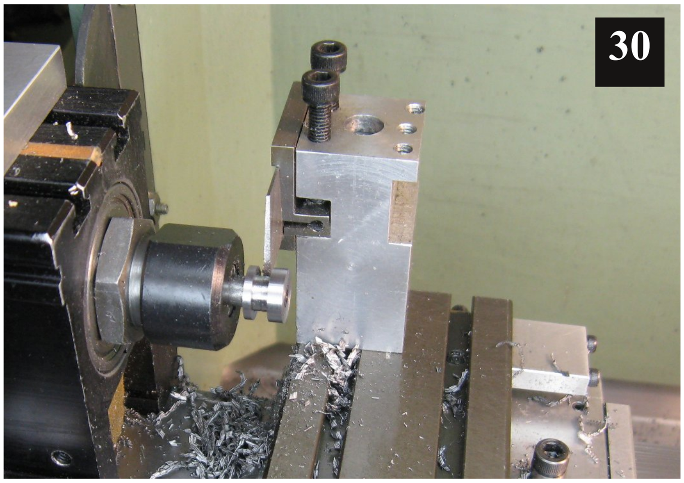
Drill through #35 (.110) for a snug clearance fit on the thread portion.

Press the 4-40 x 1" leadscrew into the dial until the head is flush.

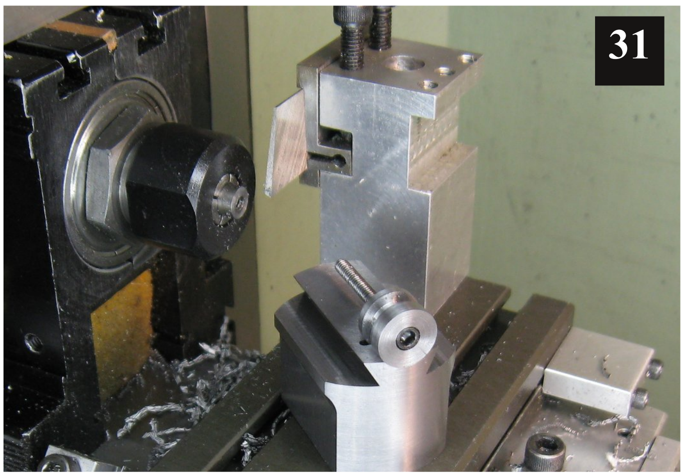


The dial must be removed and remounted during its turning to do trial fits in the base and head. To ease this process, make an arbor which can be held in a Taig 1/4" collet. Drill and tap 4-40".

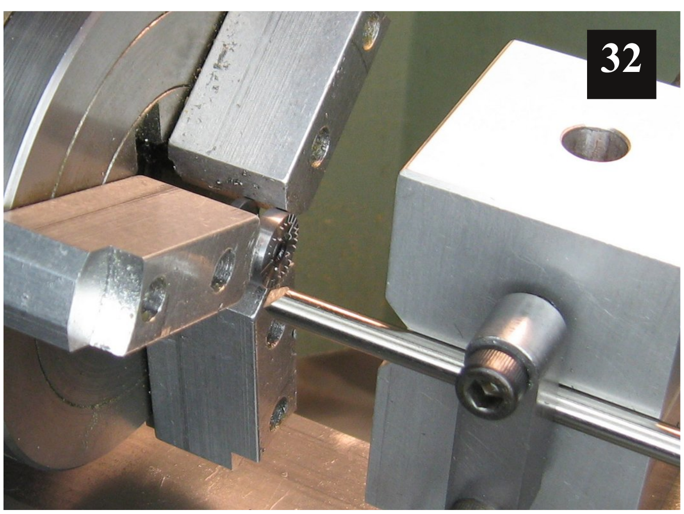
After turning the initial 7/16" diameter, test in the base recess to ensure concentricity and smooth movement through the total leadscrew travel.



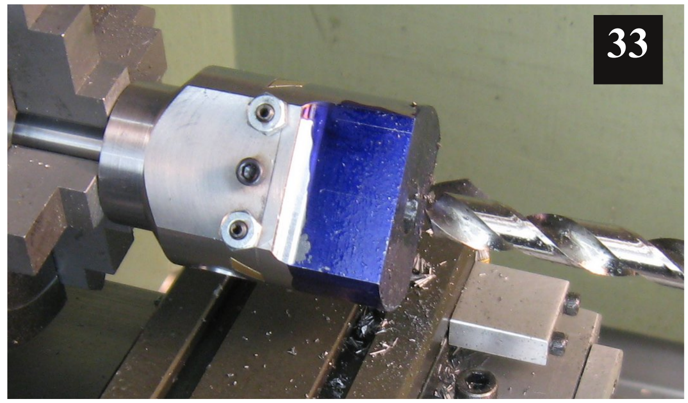
Use a cutoff tool to relieve the central part of the dial to match the 1/8" section in the head.



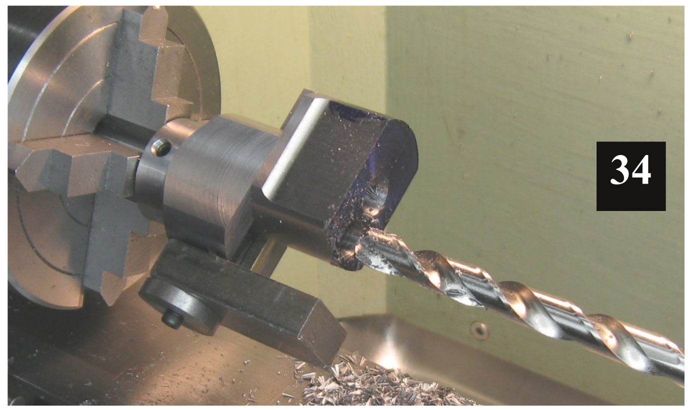
Test for fit by applying the dial to the head in its functional position. The better the fit achieved here, the less the backlash in head positioning.



Chucking the finished dial itself gives greater resistance to the force of scribing it. Use a 60 degree tool and scribe about .006" deep.



The tool holes are drilled and bored last to ensure concentricity. If the tool holes are done first, they will probably end up off center relative to the dovetail. I know, - I tried it.



It may have been paranoia but I felt more comfortable adding some balancing weight when doing the outboard hole. To finish the tool, all that remains is the tapping of the tool setscrew holes and the counterbalancing hole.