Machining the Downfeed Head and Protractor

by R. G. Sparber

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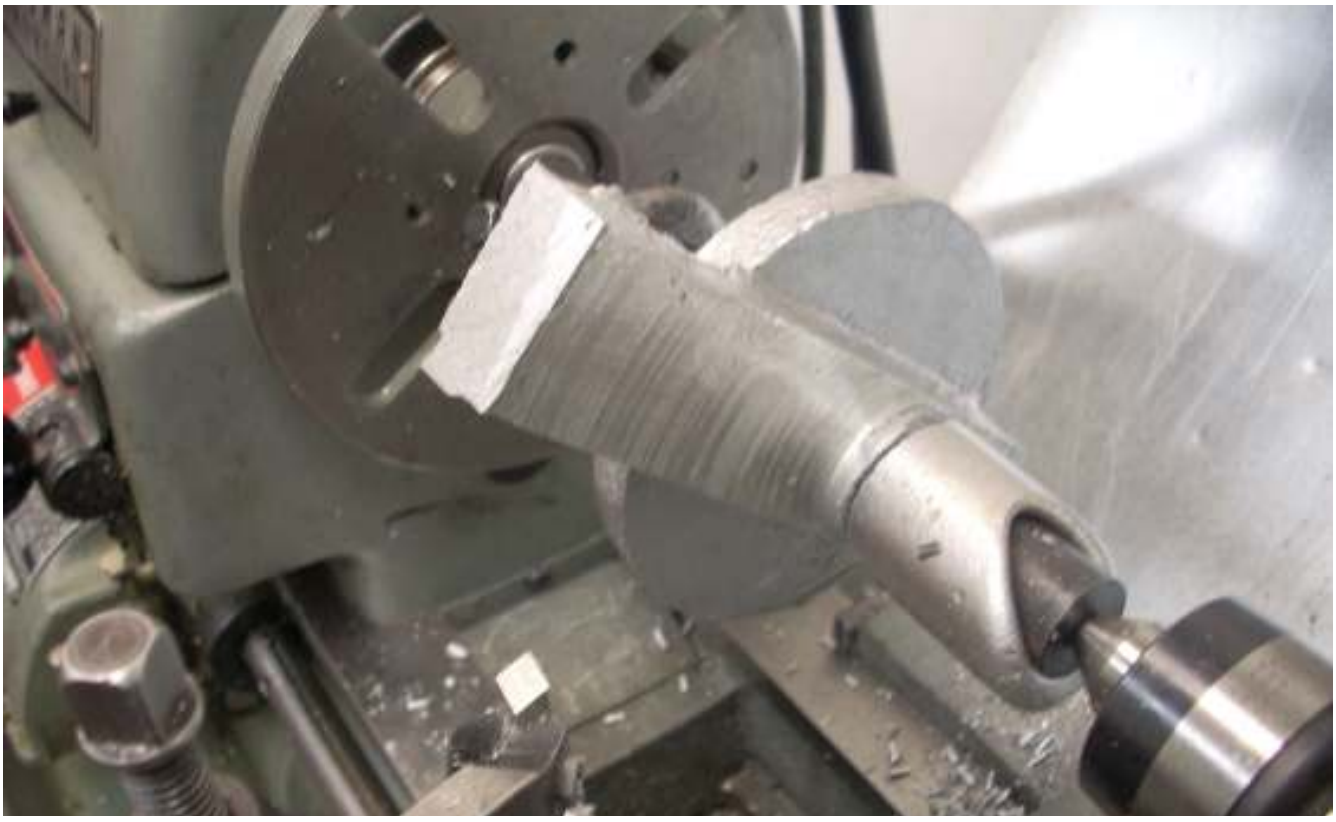
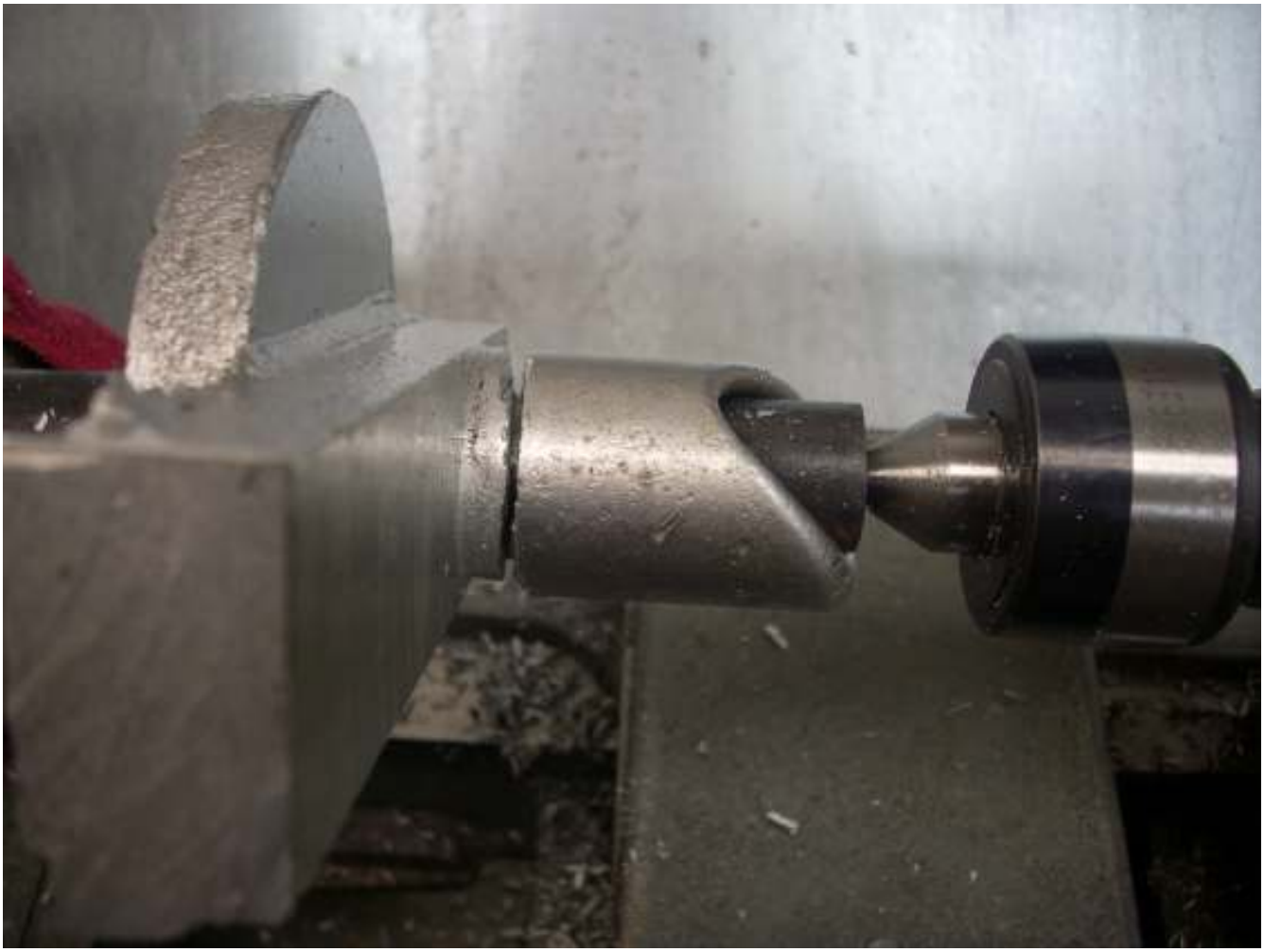
I took a few liberties with Gingery's design for both parts.

The Downfeed Head

The trickiest part of casting the downfeed head is to mold the pocket. I avoided this “challenge” by leaving the pad solid and machining the pocket later on my mill/drill.

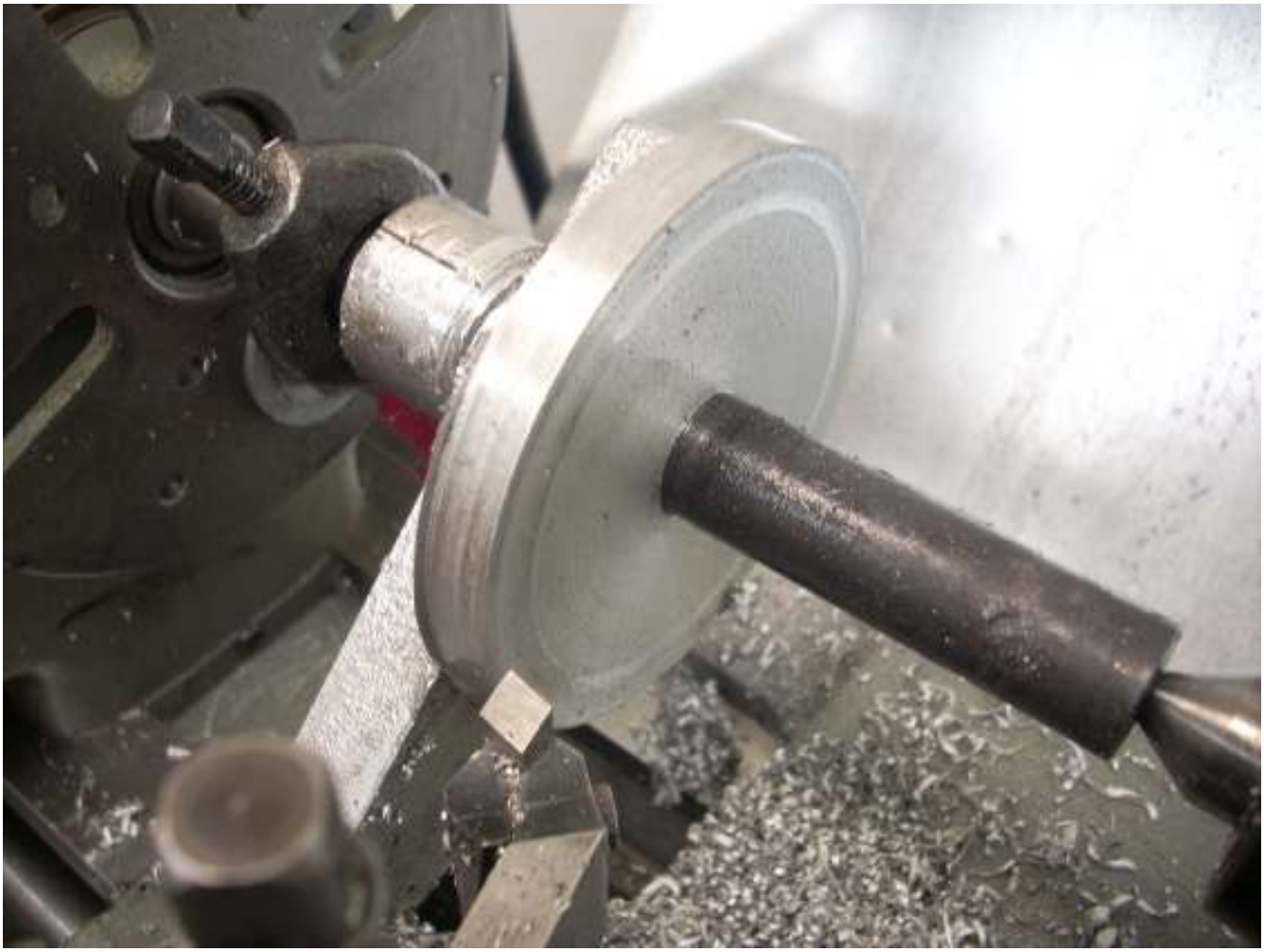


I wanted to remove the sprue from the mandrel first but this was not to be. You can see my saw cut above. The aluminum was securely hugging that steel mandrel. It was not a problem at this stage since I was just truing up the top of the pad. At almost the last step in machining this part, I realized I had wasted my time cutting this face. The mill/drill was needed to clean up the cut end of the cut off mandrel so it was easy to clean up the top of the pad at that time.



The cleaned up surface is true enough but it sure took a long time due to the low RPMs needed for such a large effective diameter and discontinuous cut.

In order to fit the dog on the sprue end of the mandrel, I had to cut away some some of the scrap aluminum. I freehand cut the sprue metal on my bandsaw but the semicircle of aluminum held tight. I ended up prying it off with a chisel and large hammer. Heavy swings with a hammer on my precious casting is not a happy time.



The back side of the downfeed head was trued up next. The cast disk was off true by about 0.1” so I just cut until the surface was fully machined. The disk's thickness came out about 0.05” under size. Fortunately, this dimension is not critical. In hindsight, I think I should have made the disk about 1/8” thicker to allow for my less than stellar casting abilities.

I put this piece aside for later mill/drill work and took up the protractor casting.

The Protractor

This disk was a bit crooked too so I just faced each side until it was fully machined.

In the end, the disk came out nice and true.

Gingery specifies the diameter of the disk so that a standard ruler can be used for the protractor tick marks. I chose to just measure the cleaned up disk's diameter and make the ruler in my CAD program. I use DesignCad Version 14 and it turned out to be very easy to generate the artwork. I printed out both the artwork and its mirror image. I will later take it to Office Max® and have a copy made on clear plastic. The right reading artwork will be used now to verify all fits right. The plastic copy will be flipped over to protect the lines and text. Two screws will hold it to the disk as Gingery did with the ruler.

Fitting The Protractor

Gingery explains how to remove the mandrel from the protractor disk. Put a drop of oil on each side of the disk on the mandrel, give the mandrel tap, and out it comes. Well, not for me. I had to give it ever heavier whacks with my largest ball peen hammer before it finally came loose. Not the best way to treat a part that has just been carefully machined square[1].

I then marked out the two mounting holes and drilled them with the clearance drill for 1/4-20. You can see the bottom hole clearly but the top hole is partially hidden. To avoid any confusion, I have marked which hole is on top. I used a piece of scrap mandrel to align the protractor disk in the ram's pivot hole.

Holding the protractor firmly, I used my electric hand drill to spot through the top hole with my clearance drill.

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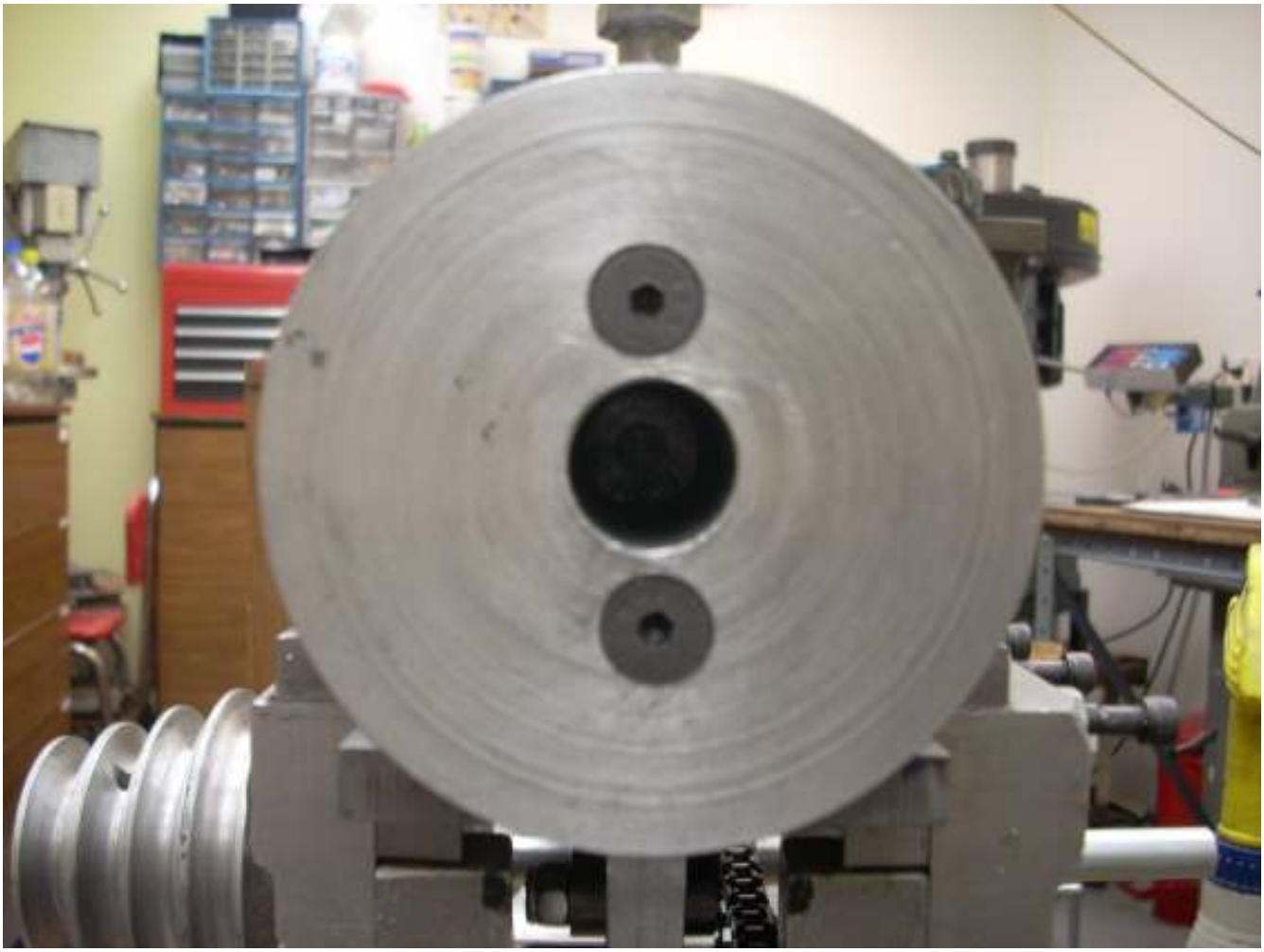
1 tiwonk@yahoo.com wrote: My only suggestion would be to soot up any metal cores better so less whack and more slide! <grin> (Ah, I knew I was doing something wrong!)

I then used my bench block and my tap drill to complete the hole. The bench block was used a second time to guide the 1/4-20 tap.

The protractor was then taken back to my drill press for countersinking. I run the drill press up to full speed and then cut power before lowering the countersink into the hole. It takes a few passes but the results are better than trying it under power at too fast a speed.

You can see that I now have one hole completely done and the screw in place. The screw and rod guarantee that as I drill my second hole, all will be in alignment.

You can see the cone left by the end of the clearance drill.

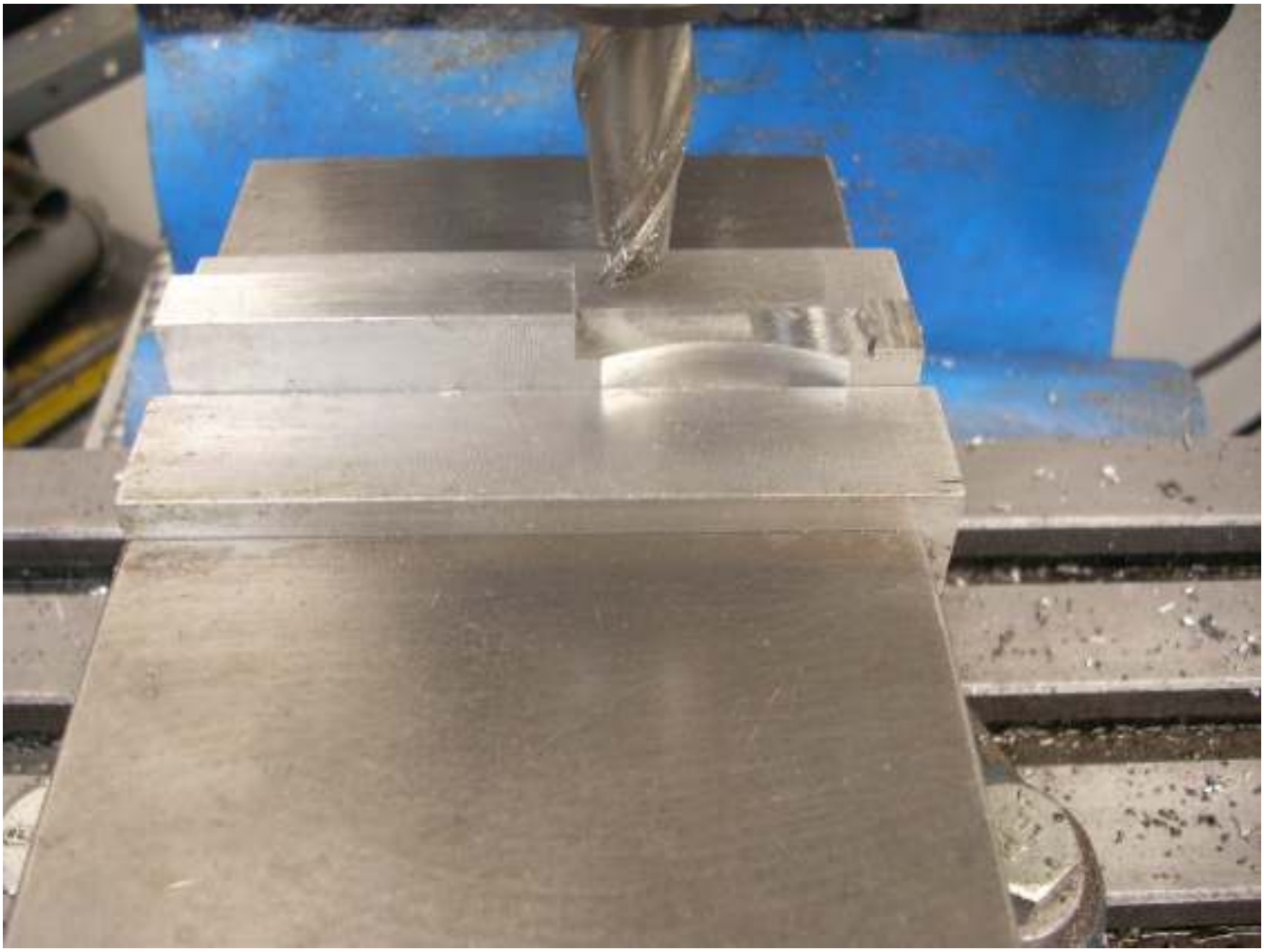


Using the same procedure with the bench block, tap drill, tap, and countersink, the second screw is secured. Note that the disk is too large to fit between the ram ways.

If you look carefully in the above picture, you can see my Gingery drill press. I use it often.

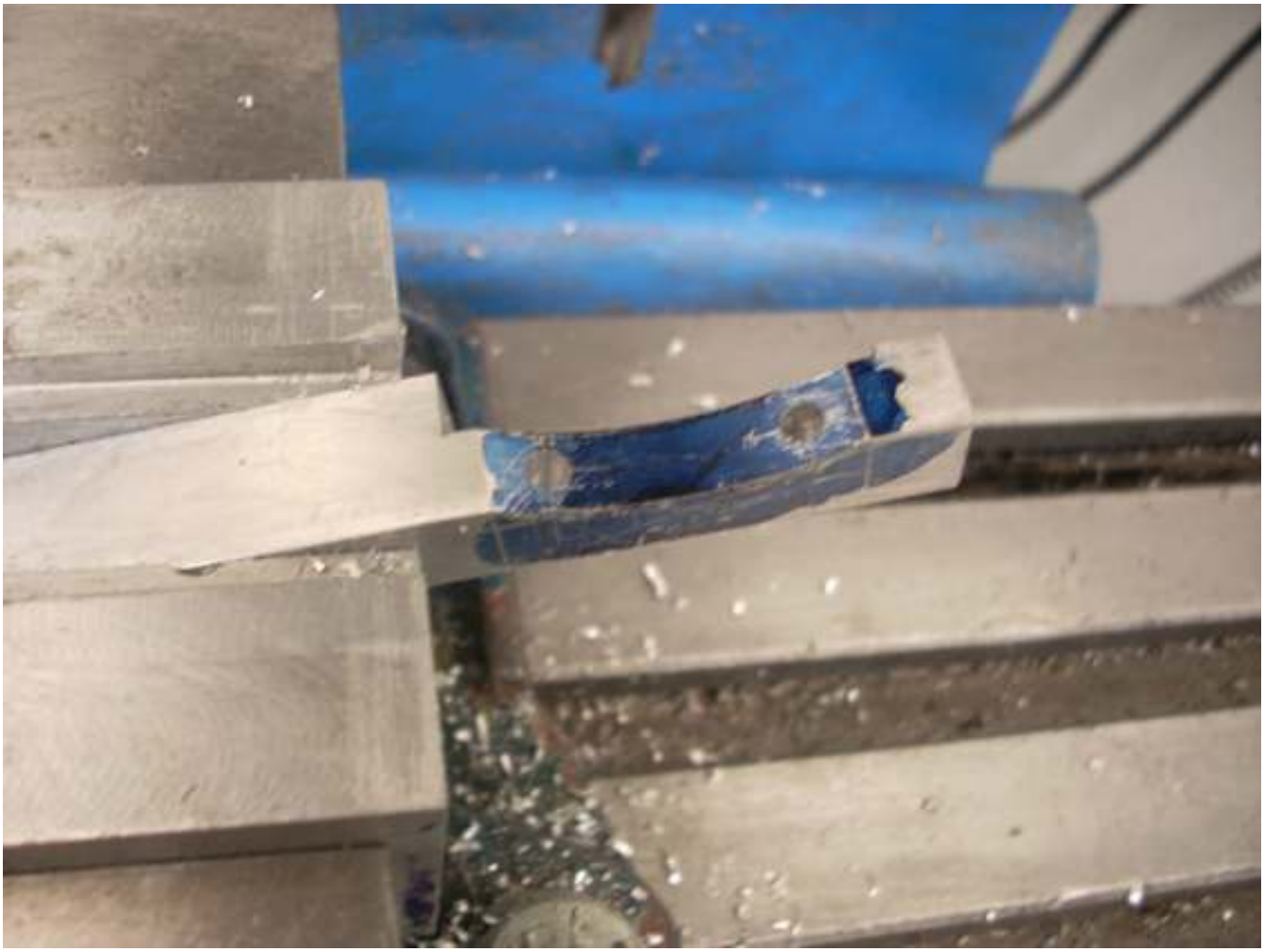
A Little Side Trip: The Protractor Pointer Block

For some crazy reason, I decided I wanted to make a fancy pointer support block using a trick I learned decades ago but never got to try. I measured the diameter of the downfeed head disk and set my boring bar cutter to match. A piece of scrap aluminum was then cut so it will make full contact with the disk.



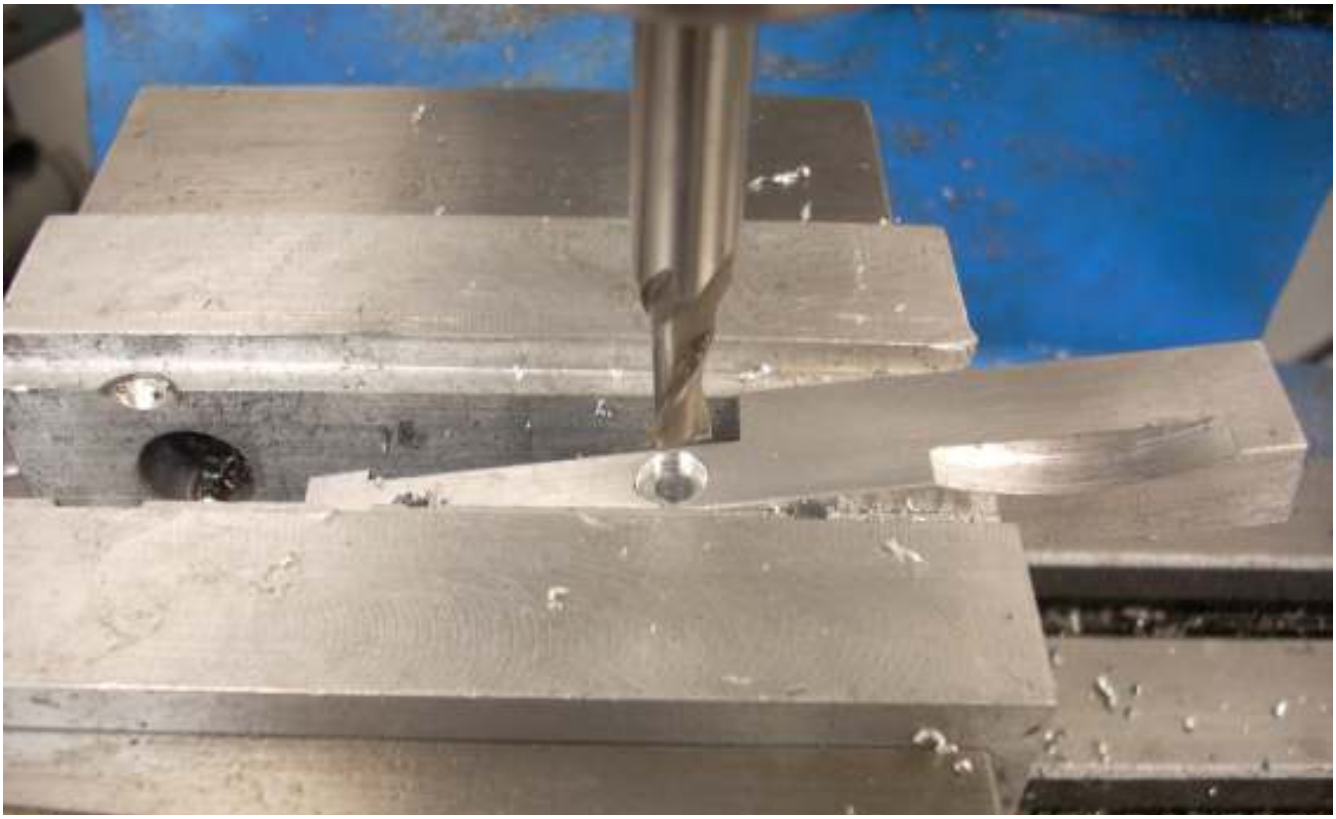
The width was milled next. Note that the curved part is left attached to the bar. This makes it much easier to machine.

I eyeballed the tangent of the curve at the two points that will pass screws. Here you see the first hole being center drilled.



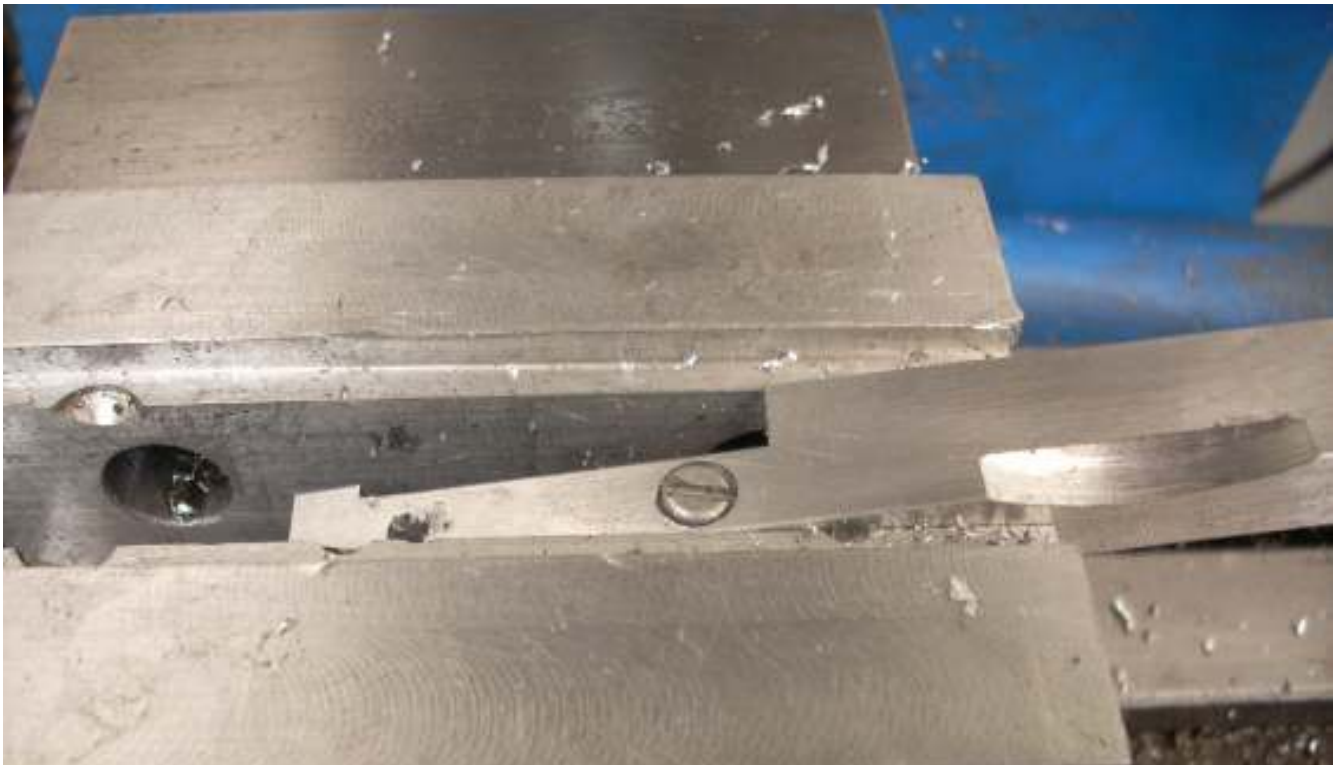
I have now drilled both clearance holes.

The curved section on the bar was a false start. The curved section that will be the final part is facing down. I am using my clearance drill to align the bar in preparation for counterboring.

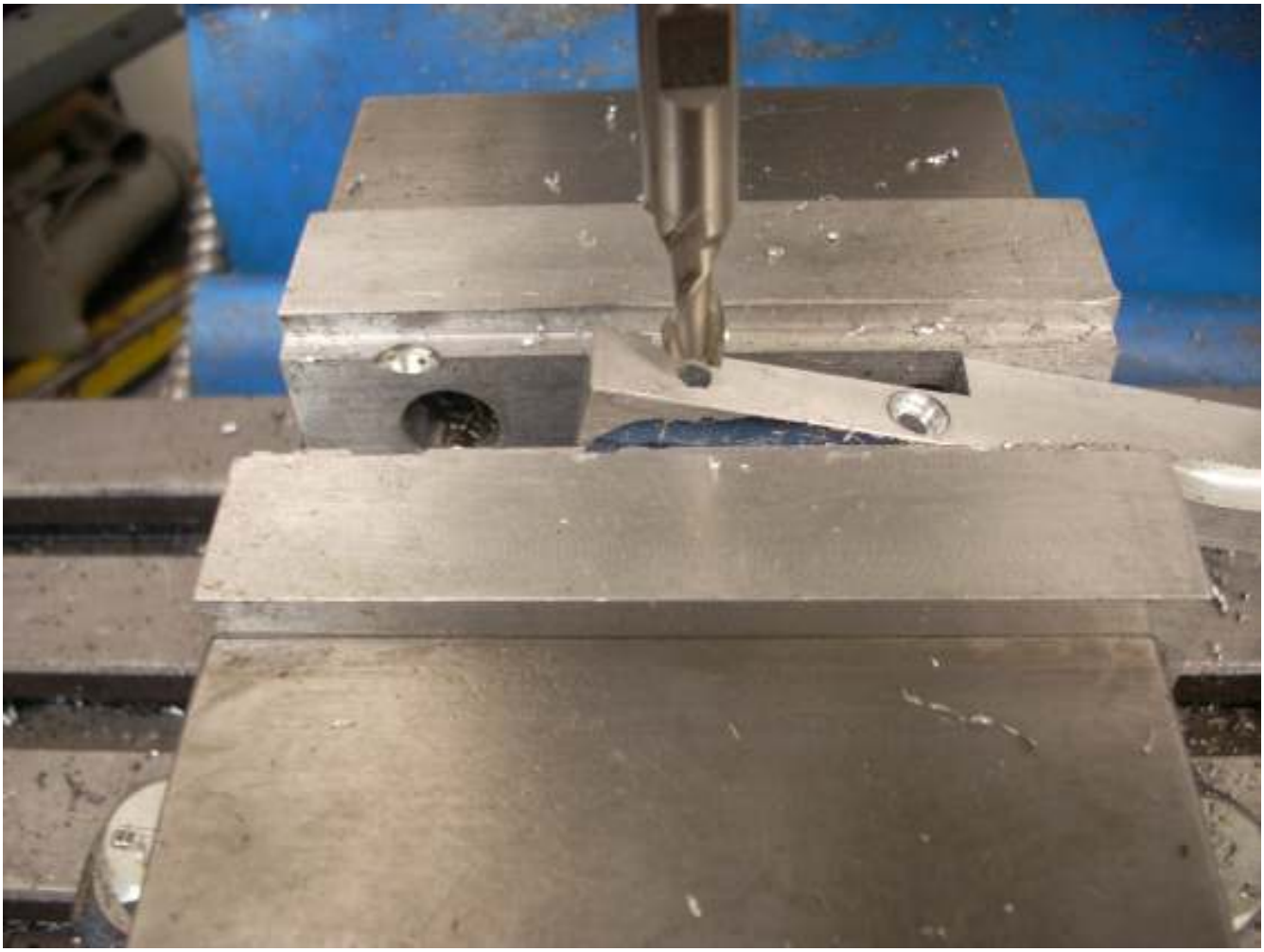


I have chucked a 2 flute end mill into my drill chuck but this is OK because I am only drilling with it. Never try to mill with an end mill in a drill chuck. More than likely, the chuck will break loose from its tapered mandrel.

The first hole has been counterbored and my screw used to check the depth.



Pretty nice fit for eye balling it.



The second hole is now being counterbored.

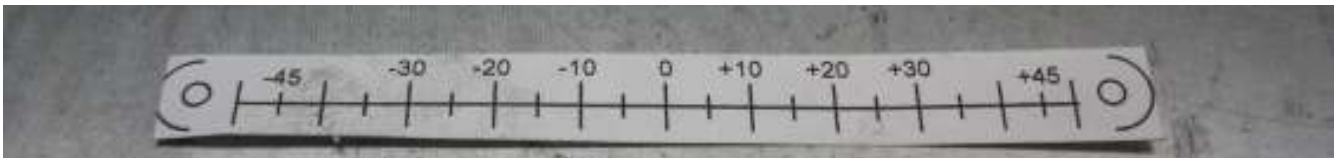
With both holes machined, I then sawed the part to rough size and cleaned up the ends by milling.

The block was pressed against the downfeed head disk and the first hole spotted through with my clearance drill. The tap drill and 6-32 tap were next. Once the first screw was fitted, I did the second hole. Here you see the block mounted. It turned out to be a rather close fit.

The block even came out square with the disk which is something that I never get without using a lot of fixturing and my mill/drill.

The block is entirely unimportant and will be difficult to even see. Yet it came out perfect. This is a common occurrence in my shop. The more important and/or visible a part, the more likely I will screw it up. Oh well, it was fun to make and try out a few new tricks.

I filed a narrow groove in the top of the block and applied some red nail polish. You can see the prototype ruler taped to the disk. I got turned around and put the numbers on the bottom rather than the top. No problem. I quickly fixed the artwork.



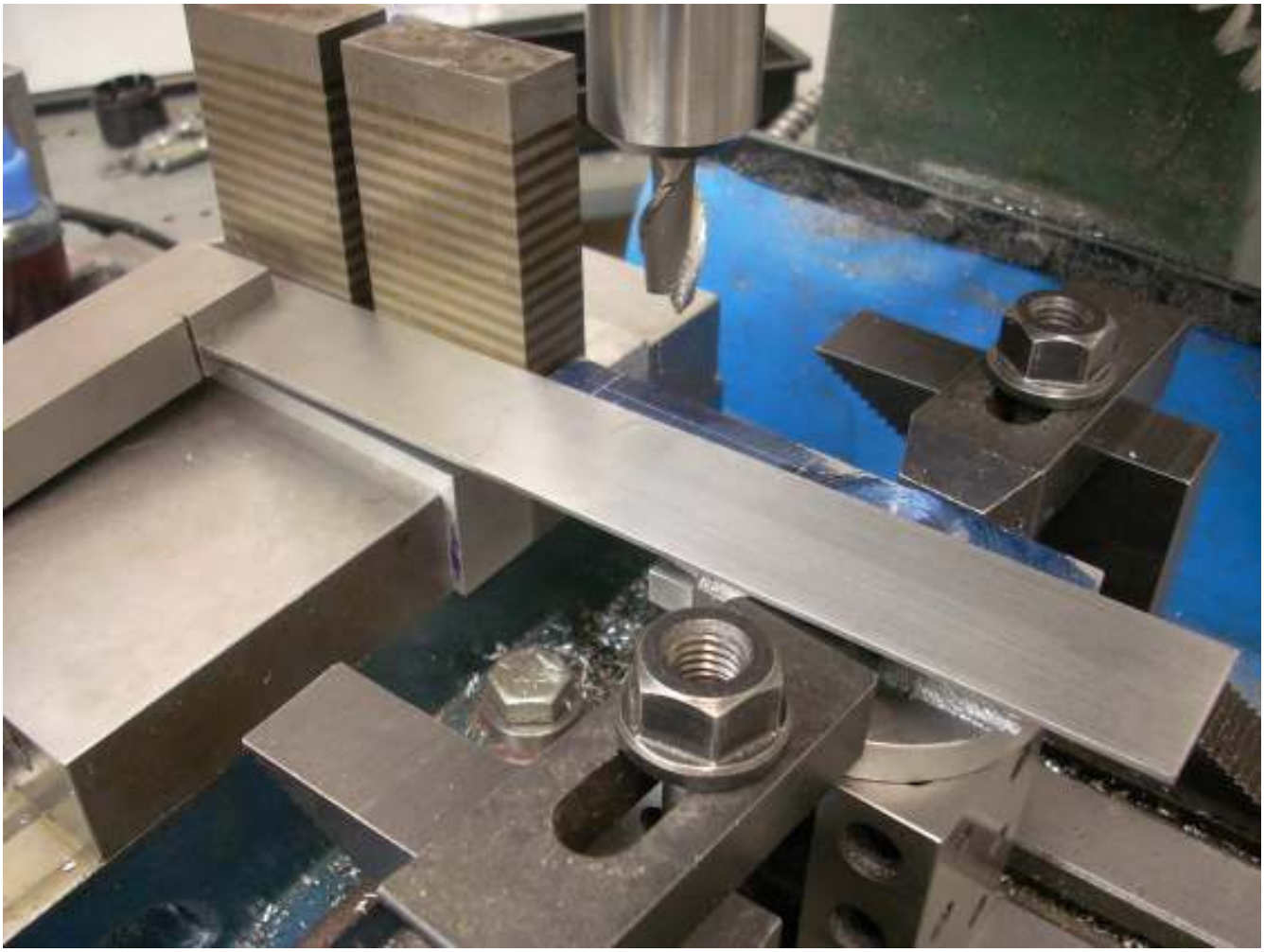
Now, that's more like it. The plastic version will be trimmed a bit closer so the lines extend to the edge and the curved lines are removed. You can see that I have drawn in the screw holes too.

Back to the Downfeed Head

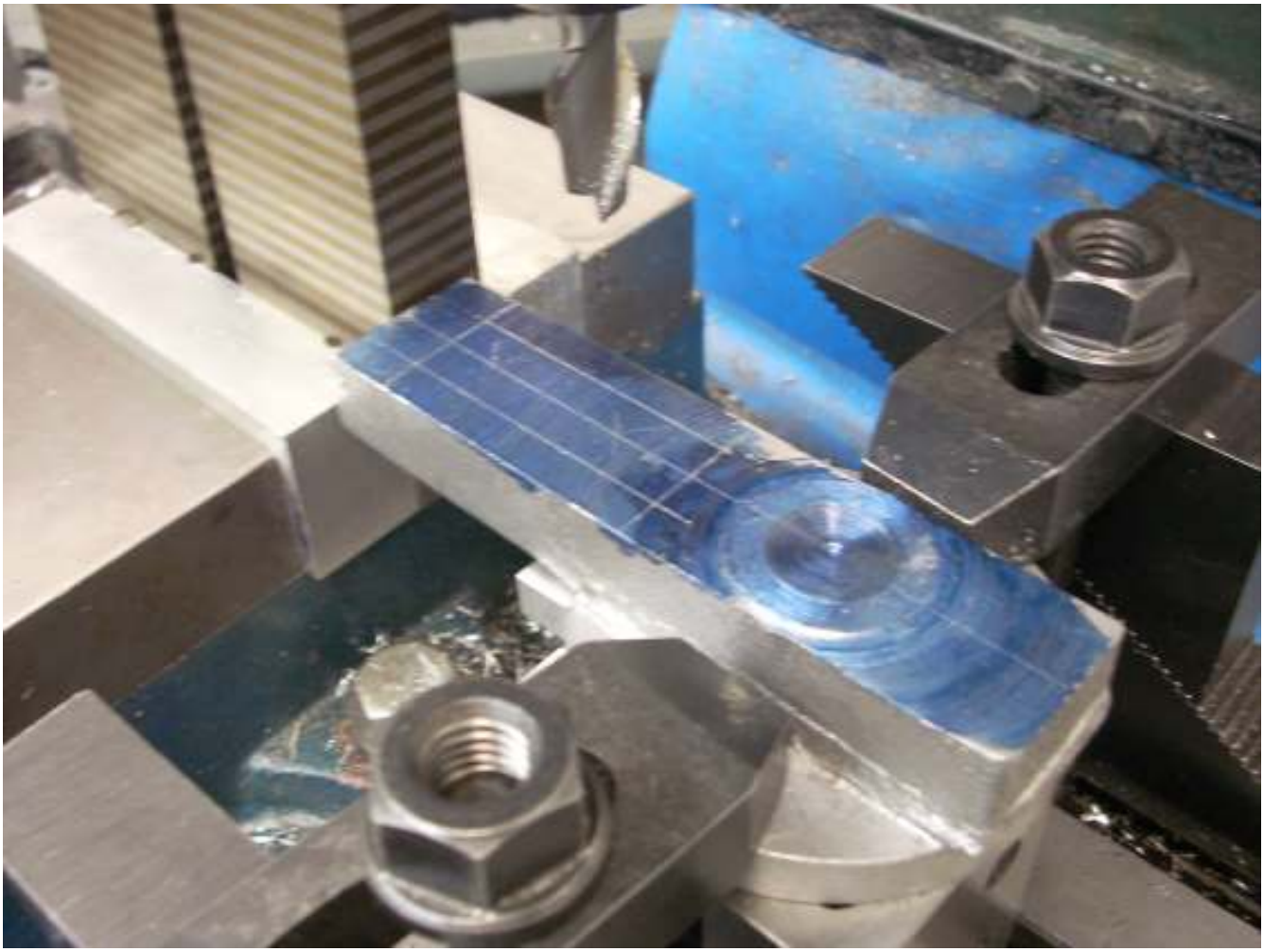
Before I can saw off the mandrel, a groove must be cut to prevent the ram's locking bolt from upsetting the pivot rod and causing binding. This is easy to do while the mandrel is intact. Once cut, it would be a lot harder to do.

I then cut off the top end of the mandrel, put it in my lathe's 3 jaw chuck, and squared up the end. I then center drilled it just enough to identify the center. This mark will be useful as I set the part up on my mill/drill.

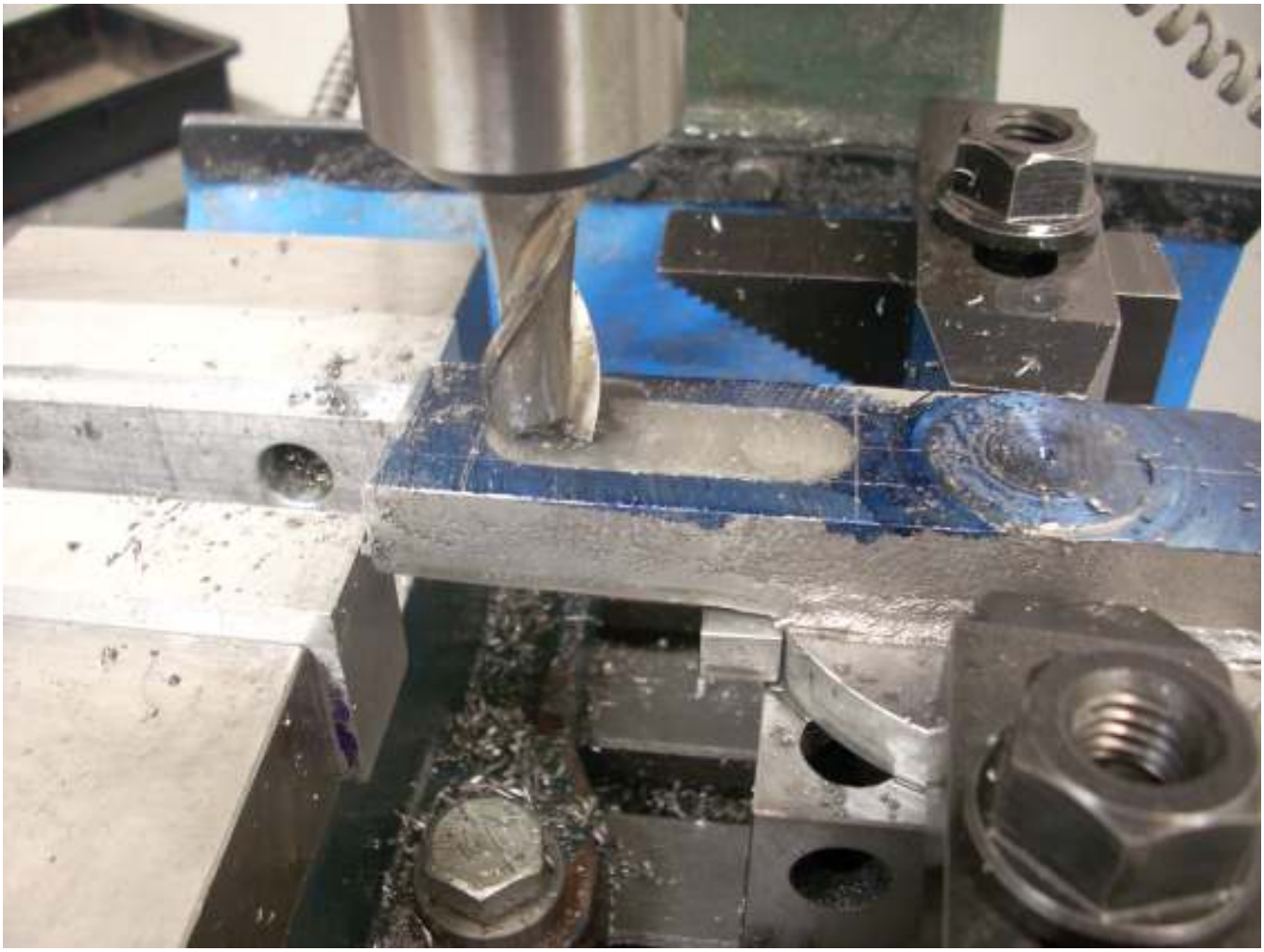
Mill Work on the Downfeed Head



The first step is to set the downfeed head such that the pad is aligned with the X axis of of the mill. My vise is true so I used a square to transfer that orientation to the casting.



The pocket has been marked out. I will take a series of 0.050” deep cuts with my 5/8” end mill. Gingery called for a pocket but I believe that was because it would be too difficult to mold a hole. I chose to just mill all the way through. While I'm at it, I will take a light cut across the top of the pad since I must clean up around the pivot rod anyway.

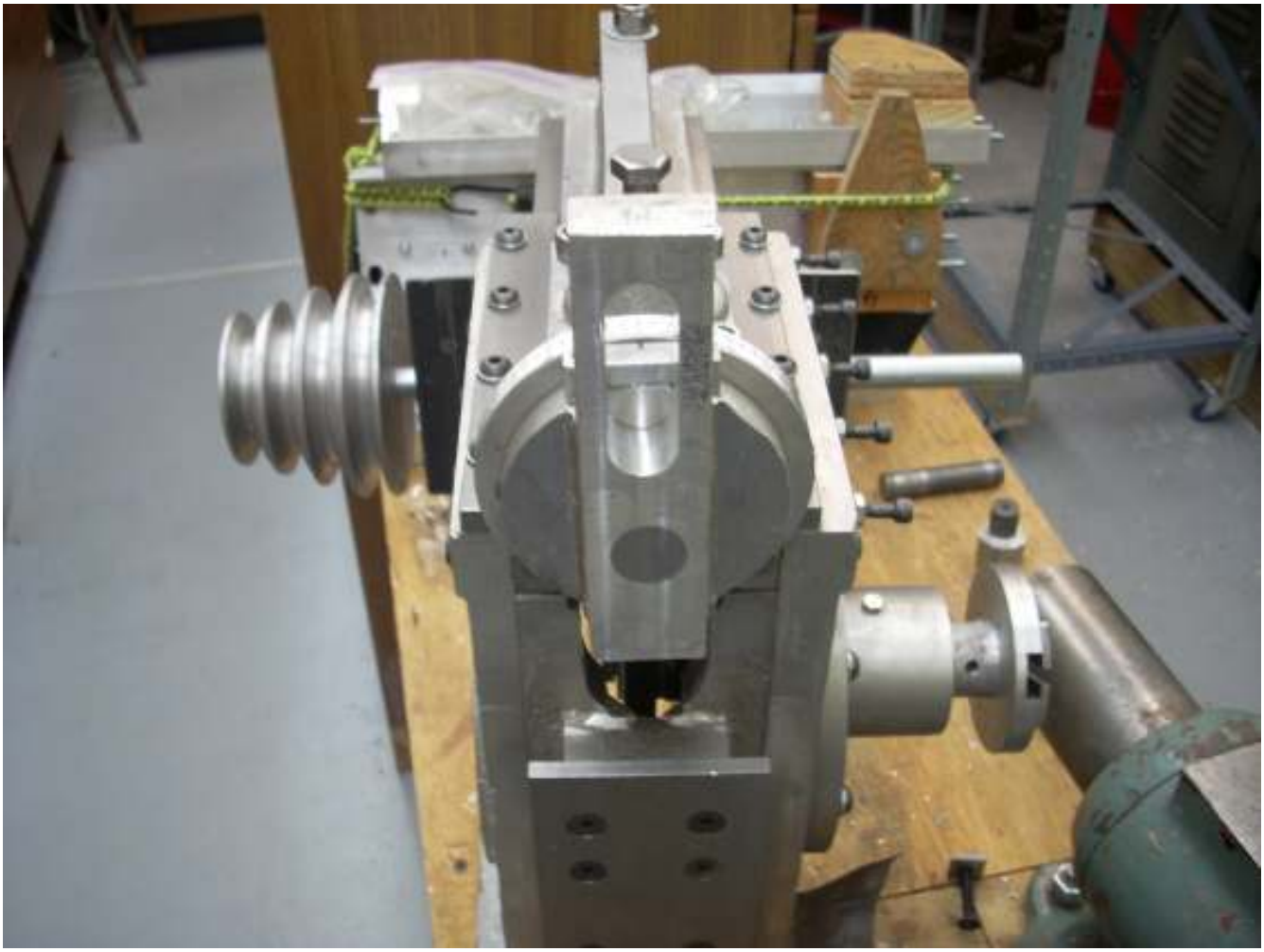


I have taken a 0.01” deep cut just to verify my layout and cutter position.

All was going fine when suddenly the cutter snatched the side of the hole and took a bite. I'm not sure why the part moved[2,3] It was clamped down rather tightly but obviously not tight enough. I realigned the slot using the cutter as my gage and finished the hole.

2 Donald Qualls wrote: I can make a suggestion why the mill cutter grabbed while cutting the slot while the head casting was well secured, the portion you were cutting was extended and may have flexed under the cutting force; once the cutter started to grab, the force would increase rapidly and become high enough to slip the part in the clamps, but it was likely flex that started it (the same thing that causes chatter when you have too much tool or part overhang).

3 One solution is to place a jack under the end of the pad to support it and then place a hold down clamp on the top. RGS



Except for that little bite out of the side of the hole, the pad came out OK. I used WD40 to cut the aluminum and then changed to cutting oil when milling through the CRS pivot rod.

I have now machined all of my castings from my last batch. Doing foundry work is going to be a little difficult because we are now in monsoon season. Rain storms blow up quickly plus the combination of high temperatures and high humidity is no fun to work in when wearing full protective gear. Well, I can at least make patterns and hope for a few days of dry weather.

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