Machining the Ram Casting

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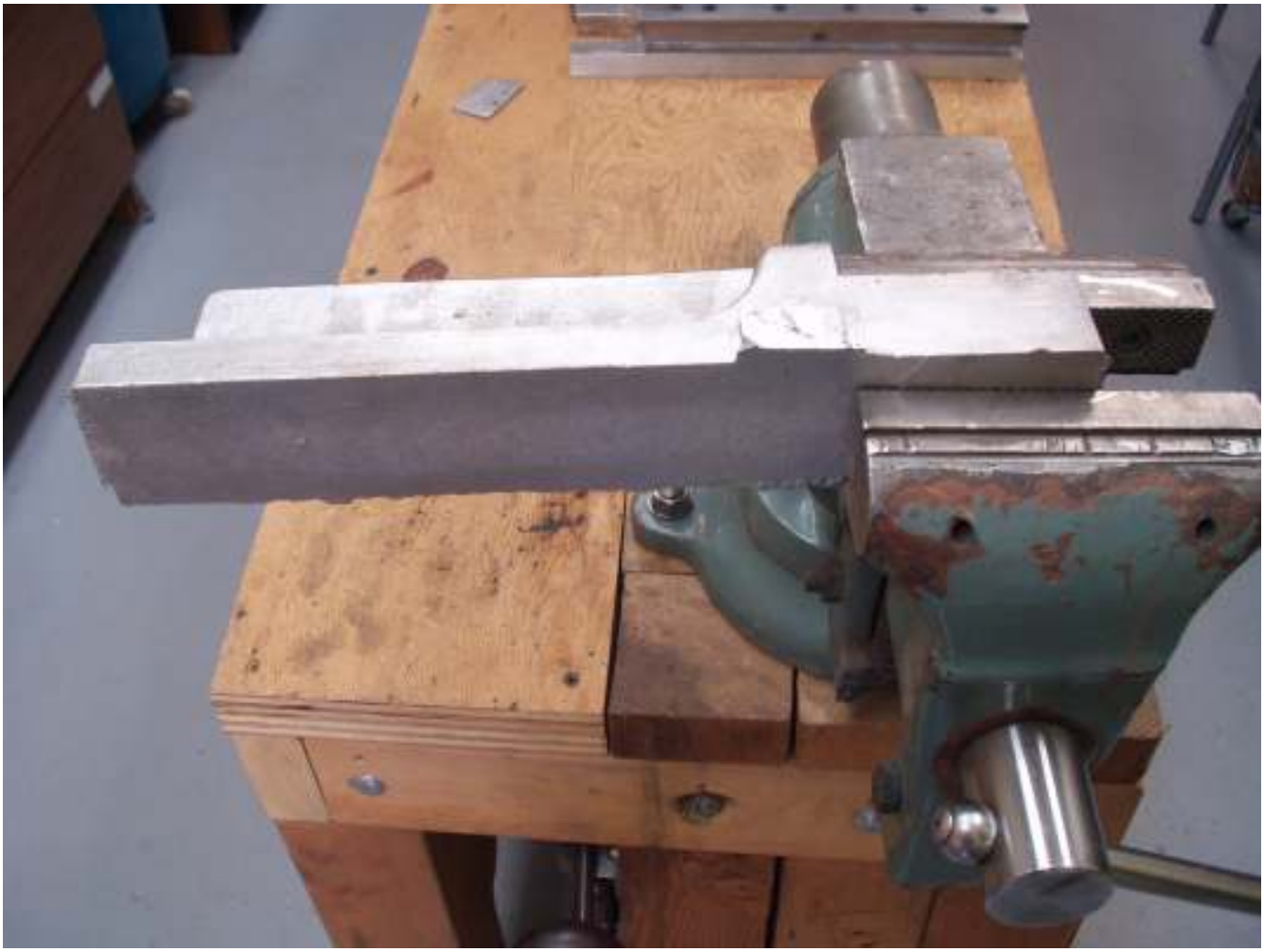
Overview

I have read more about how to machine the ram casting than any other part. Gingery suggests using a steel core to make the pivot support. Given that I have a lathe and mill, this seems like more trouble than it is worth. Others have suggested ways to fix errors in this pivot support due to casting distortion. My plan is to just leave it out. Using suggestions from many good sources, I plan to machine the bottom, then the sides. These will be my first 2 reference surfaces. I will then machine the cap. It will be bolted to the body of the ram with 2 five thou shims. The center of the bore will be the line between these shims and half way between the machined sides. If this is not clear, pictures to follow. I plan to mount the ram with fitted cap on my lathe's compound, fly cut the front and then drill and bore. In this way the front of the casting is my third reference plane and the bore is perpendicular to it. When that is done, I will mount the steel plate.

Rough Clean Up

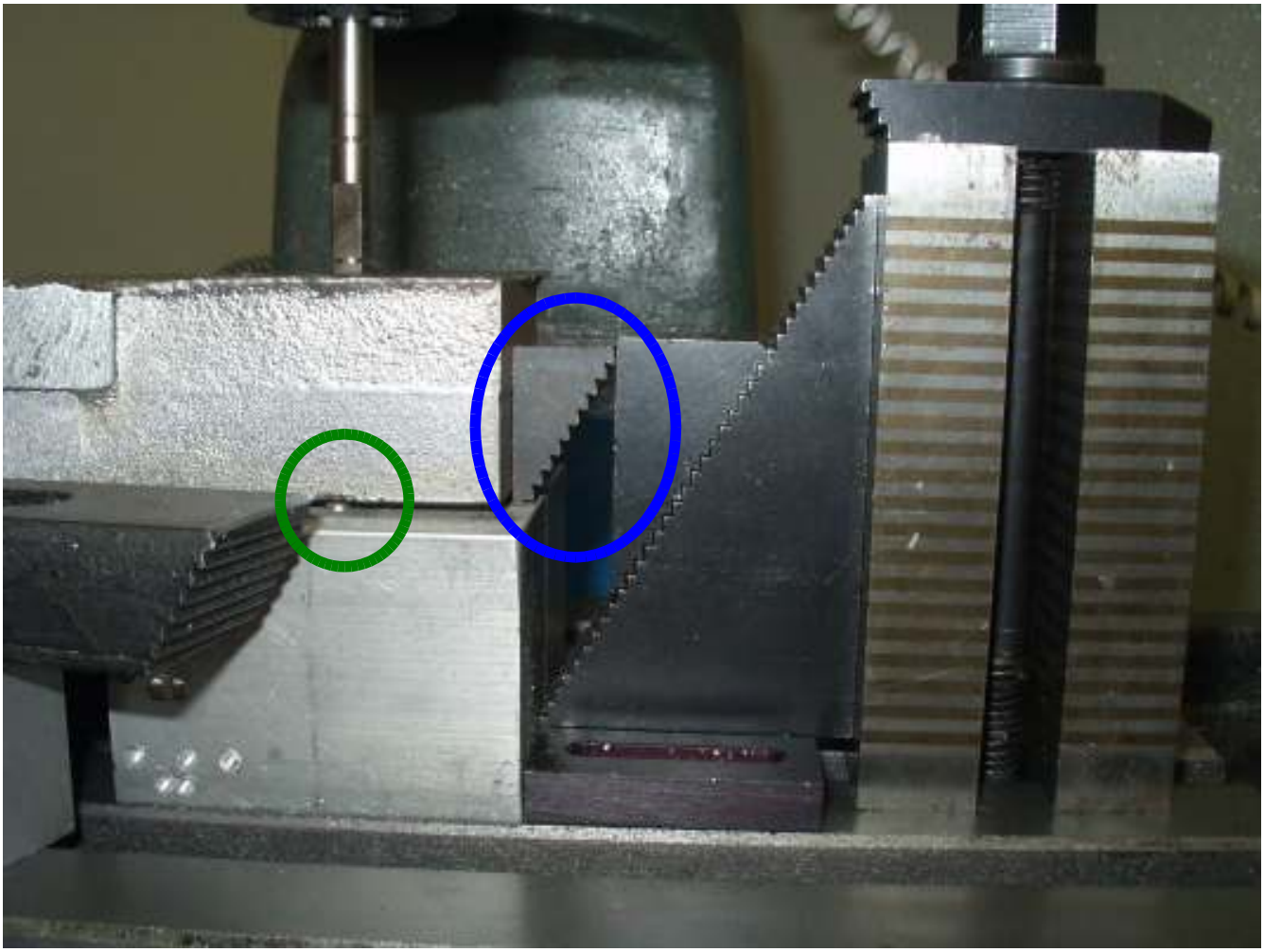


The bottom and what I call the “non-crank” side of the ram are fairly clean. You can see a bit of the runner near the left side of the vise jaw. I filed off some of the flash.

I learned a lot about casting from doing (almost ruining?) the column side plates and front plate. This time I am using my ball bearing support blocks on the front of the casting (right side of table) and a jack for the third point to support the back of the casting (left side of the table). I have also arranged the hold down clamp hardware so the entire bottom of the casting (the top face) is exposed.

Movement of the casting along the X axis is prevented by a toe clamp on the left and a floating block on the right. Y axis motion is prevented by blocks pressing against the vertical section of the casting. Z axis motion is prevented by my 3 point support and the downward force of the toe clamp and floating block.

I used a level to get the casting reasonable level along the X and Y axises.



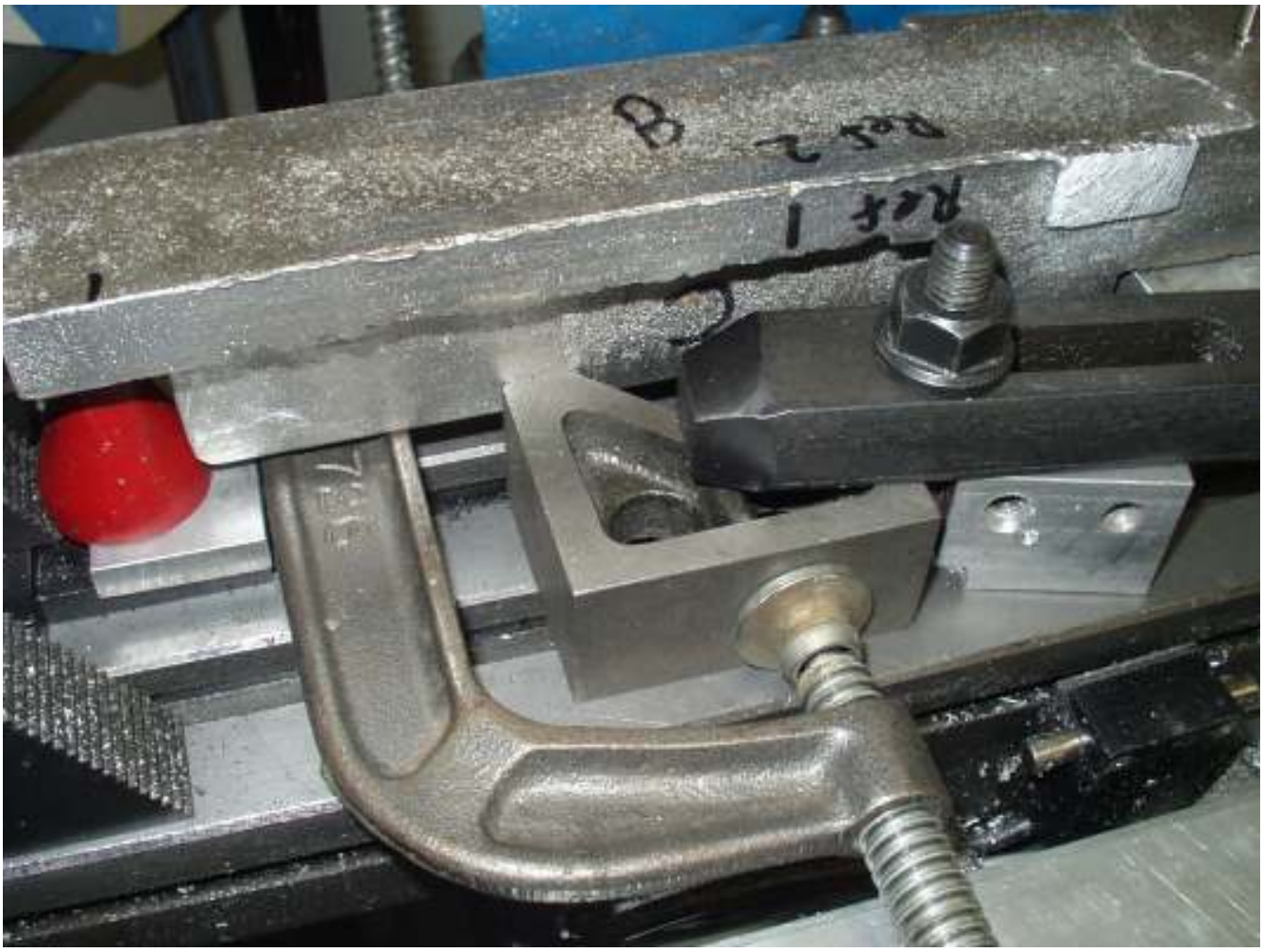
Here is a close up of the floating block, circled in blue. The idea is that the force from the toe clamp at the other end of the casting will push against this triangle block. Since the block is only supported at the top, it will tend to rotate counter clockwise. That will cause the top edge of the block to dig into the casting and push down. It did work fine so I guess there must be something to my reasoning. In hindsight I can see that it would have been better to leave a gap at the bottom of this floating block so the aluminum blocks don't prevent rotation.

You can barely see one of the ball bearings embedded into the aluminum block. I have circled it in green.

Over at the left end of the casting I have my third support point. It is a jack which enables me to easily level the casting. You can see the triangle shaped toe clamp which I have circled in green. When first placed against the casting, this toe clamp was at about a 45 degree angle. Once tightened by pressure from a hold down clamp, the triangle block is almost horizontal. That is not good so I had to adjust it back to its original orientation.

Here is the view from the column side of the mill after adding a bit of packing. You can see the toe clamp now closer to the correct angle.

If I used this arrangement at both ends of the casting, it would have been difficult to balance the forces. It is better to just push on one end and then use that force to lock down the casting at the other end.



Y axis support is with a pair of cast iron V blocks. I first used the C-clamp to lightly push the blocks into the casting and then lightly tightened down the hold down clamps. The C-clamp was then firmly tightened followed by firmly tightening the hold down clamps. If the C-clamp was full tightened first, it would prevent the blocks from seating onto the table. Similarly, clamping the blocks to the table first would have prevented them from pressing fully onto the casting.

One last check – walk through the effects of forces along all 3 axes to be sure that nothing can move. OK. Then I ran the cutter above the surface to verify that there was no problem with interferences or with lack of movement of the table. It is a bit close on the left side but that just means I will advance the table that last 1/4” by hand.

All is Clamped, Let the Machining Begin!

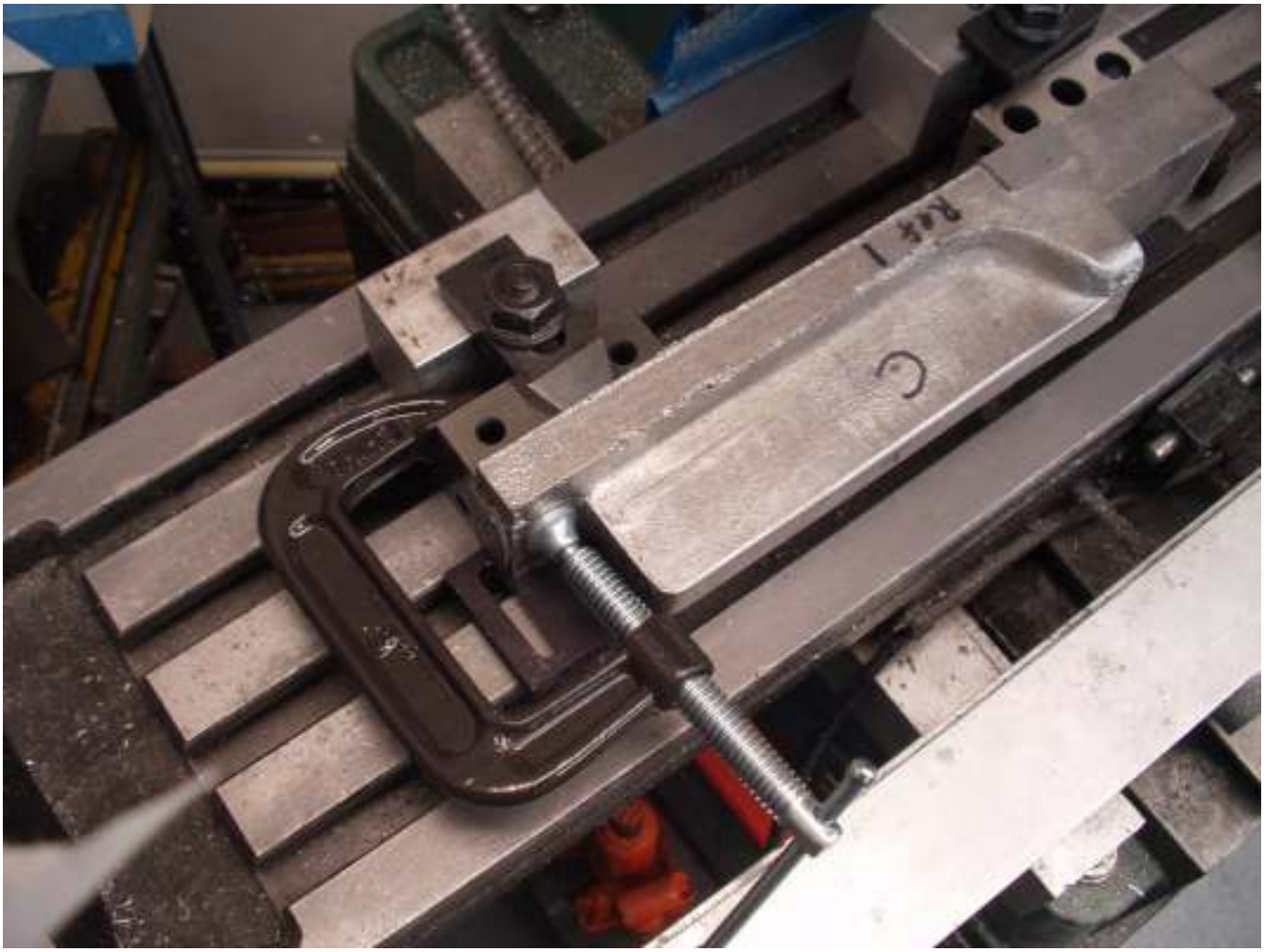
I am using a shell mill with brazed carbide cutters. It runs at the mill's maximum speed of 2500 RPM. I am feeding the table at about 1 inch per minute. Each pass was 25 thou except the last one which was 5 thou. I only used cutting fluid on the last pass. Not sure it mattered.

You can see a casting problem in the above picture. After my first pass I have removed 25 thou from the highest point. The area missed is from shrinkage during the cooling of the aluminum. Note that heavy gates were placed on both sides of this area and they lead to 1” diameter risers. It looks to me like the gates froze before this heavy section froze. This caused the available aluminum in the gates and risers to not flow into the body of the casting. Maybe pouring at a higher temperature would have helped. Another trick I've read about is to cover the risers with sawdust which will act as an insulator. The shrinkage did not spoil the casting but there certainly is a lesson here. Not sure exactly what it is...

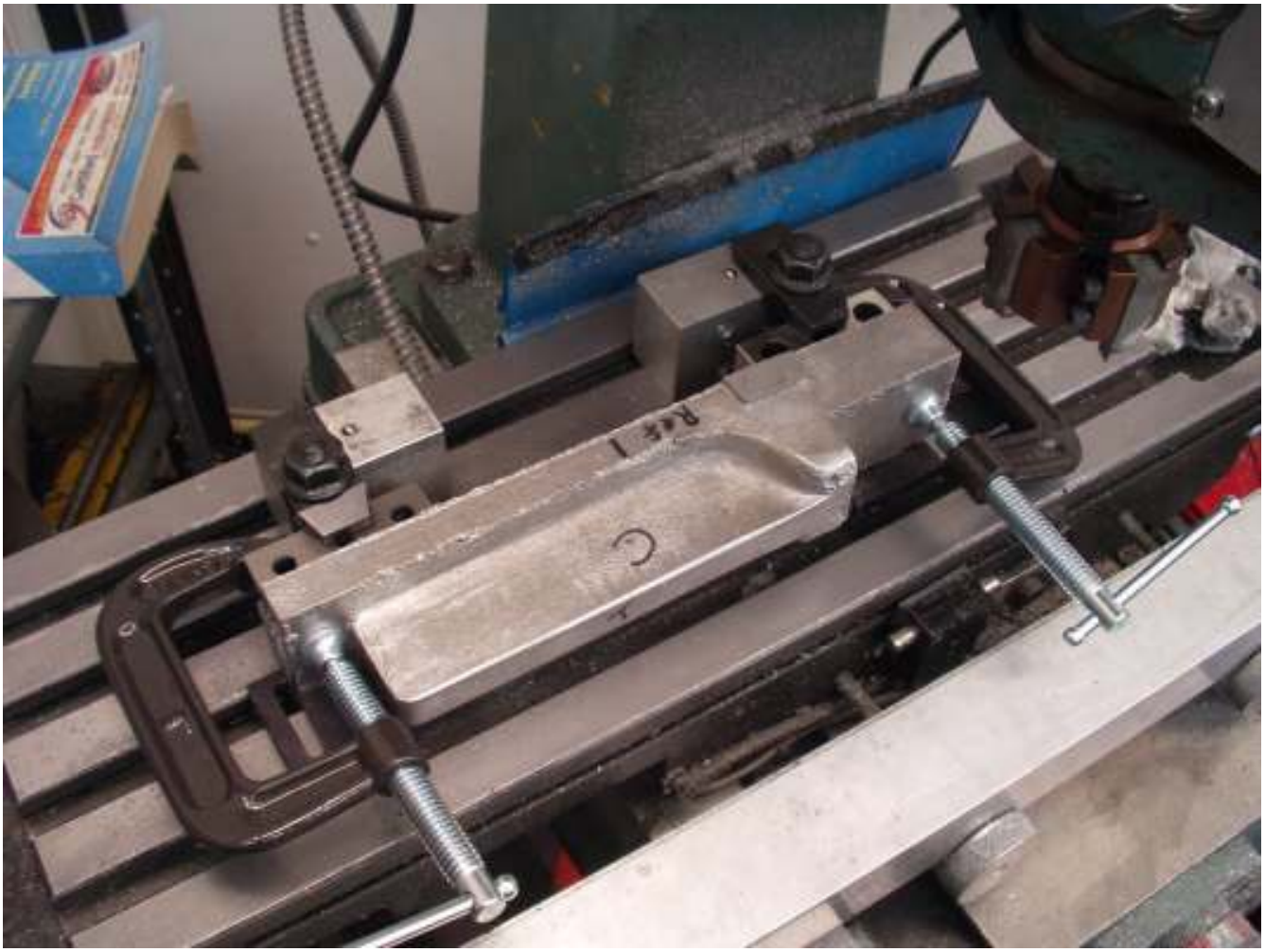
On the second 25 thou deep cut you can still see signs of shrinkage.

My third 25 thou cut looks good but you can still see signs of the shrinkage. If you look closely, you can also see that the head of my mill tilts slightly to the left. This causes the left side of the shell mill to cut a little more than the right side. The result is that the left end of the casting has a uniform cut. Over on the right side, inside the black circle, there is a change in surface finish where the cutter stopped. I could not go further without hitting some hold down hardware. Actually, on the finish cut, I did just kiss the right large triangle block but managed to survive with minimal damage. Sure is hard to see those cutters when they are working. The finish cut removed the rest of this shrink void and the surface is ready to accept the steel plate. That work is for another day. Now, it is time to cut my next reference surface. Note that I cut the largest reference surface, #2, first. I figure this will give me the best change of accurately positioning the casting for the next set of cuts.

The above work took 2 ½ hours. Most of that time was invested in the set up.



I have carefully cleaned the table and placed a 123 block on its side. A hold down clamp is tightened over it. The casting is then C-clamped to this block so my newly machined reference plane is flat on the block. I used a level to get the exposed top surface approximately parallel with the table.



I then put down my second 123 block and lightly C-clamped it to the casting. A hold down clamp was lightly applied. Then the C-clamp and hold down clamp were tightened. In this way there should be no stress on the casting.

The casting is ready to have its reference surface 1 machined but that will have to wait until tomorrow. Just too many chores waiting for me this afternoon.

I would like to extend a special thanks to Brian Lamb. His generous guidance made today's work successful.

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