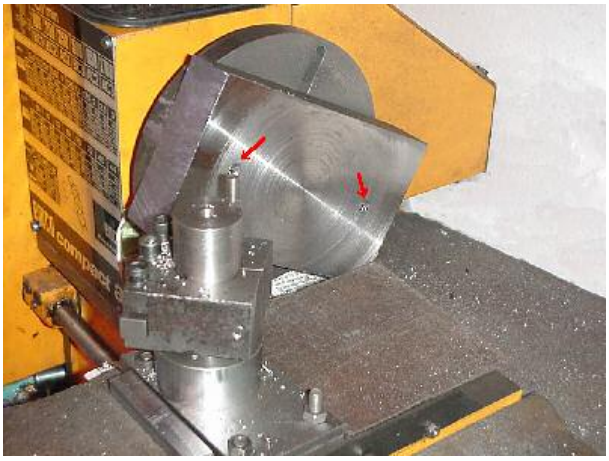
Screwless vise

A screwless vise will pull the workpiece down as well as push it against the fixed jaw. Frank Hoose (http://www.mini-mill.com) recommends this type of milling vise. He explains how the original vise uses a sort of crossbar arrangement underneath that drops into the nearest of several slots cast into the underside of the vise. Since I intended to use a 150 x 90 x 32 mm piece of HRS, there were no slots available. Frank Hoose's website also shows pictures of another version of the vise with a series of holes along the side. It should be possible to insert an Allen screw from each side through these holes and into threaded holes in the sides of the crossbar. Not as elegant and practical as the cast slots, but simpler to machine. The pictures of Swarfmaker's Screwless vise (www.wwnet.net/~radix) differ a bit from the others I have seen. I liked his construction of the movable jaw and decided to construct mine based on his ideas.

Materials

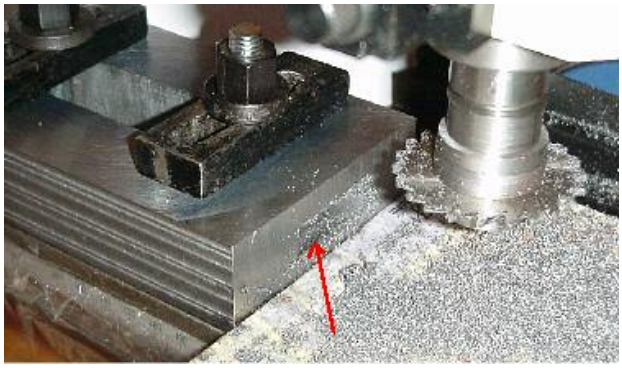
I started with a 150 x 90 x 32 mm piece of HRS for the bottom part. A 32 x 32 x 90 mm piece of HRS for the fixed jaw and a 40 x 35 x 90 mm piece for the movable jaw. I use M10 Allen screws to attach the fixed jaw to the bottom part of the vise (drawing at the end of document).



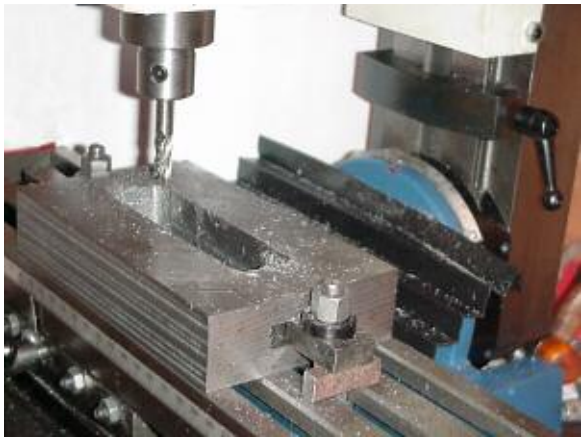
Bottom part

First the bottom part must be faced so the top and bottom surfaces are parallel. Only my lathe had the capacity to face a piece of steel this size, so I decided to drill two 6.8-mm holes in the bottom part (red arrows in the picture). Then I tapped the holes M8 and used two M8 screws and washers to attach the bottom piece to the faceplate.
When the first side was faced, the piece was turned around so the opposite side could be faced.
When I used a micrometer to measure the thickness, it varied by 0.03-mm across the length. The thickness was about 30.1-mm, that leaves some material if I want to lap or grind it.

The bottom part has a slot for the M 12 Allen screw that tightens the movable jaw, so the next operation was to drill 4 holes. One 12-mm hole in each corner, I then used a hacksaw to cut the slot roughly to size (right picture).
You can use your milling machine to do the job, however, the steel I used was very hard (tool steel) and I didn't want to destroy my end-mills.
After the hacksaw job was done I milled a slot at each end using a small slitting saw (red arrow in the picture below). This slot can be used to clamp the piece to the worktable of the mill leaving the top clear for the cutter.



After the slots were milled I clamped the bottom piece to the milling table and used a dial test indicator to make sure its sides were parallel to the milling table. I then used one 8-mm end-mill to mill the sides of the slot parallel to each other. The end-mill was rather dull when I finished.



The last cuts on the bottom part were made after the centre slot was milled. I added another clamp (see the picture to the right) and milled two 6-mm deep and 6-mm wide slots along each side. Since these were cut without moving the workpiece, the slots should be parallel to each other. These slots will act as a guide for the movable jaw.

Next I milled a 2-mm deep and 10-mm wide slot at the front. I milled the underside of the fixed jaw to sit in this slot so the clamping pressure is not just on the M 10 bolts. This arrangement will ensure that the fixed jaw is at right angles with the slots along the sides.

The bottom part was turned around and two 10-mm holes were drilled and countersunk (as indicated in the drawing at the end of this document).

Movable jaw

I constructed the movable jaw after the pictures on Swarfmaker's web site. The first operation was to drill a ø 20-mm hole through. I started with a 5-mm drill and finished with a 20-mm, see picture. Since this hole was 90-mm long I backed the drill out frequently and applied cutting fluid.

At the upper rear end of the movable jaw I drilled two holes and used a hacksaw to make an opening for the M 12 Allen screw that is used to tighten the jaw.

Then the jaw piece was moved to the mini-mill and the bottom side was milled to fit the slots milled along the sides of the bottom part. The last cuts were Very light and I tried to get a sliding fit between the movable jaw and the slots in the bottom part.

Then I tilted the angle vise and milled a small flat and drilled a 13-mm hole through to the 20-mm hole. Next I used a 10-mm end-mill to make this hole more elliptic so the M 12 screw could move back and forth.
The M 12 screw passes through a 12-mm hole in a piece of 20-mm round bar so the screw can rotate when the jaw is moved.

Another piece of 20-mm round bar was used to make a nut for the M 12 screw. At each side a 6.8-mm hole was drilled and tapped M8. For now I use M8 Allen screws to keep the nut in place when the movable jaw is tightened. When I get around to it I will mill grooves along the side (through the 8-mm holes) like Rick Kruger did with his vise.

Putting it all together

Then the fixed jaw was attached to the bottom part with two M10 screws. I attached a square block to the milling table and clamped the bottom of the vise against the side of this block. This way I could mill the sides at right angles with the bottom, and drill the 8.5-mm holes along the side, see picture to the right. A clamp used to press the vise to the block was removed before the picture was taken.
After the holes were drilled and sides squared, the vise was mounted on the milling table and a Dial Test Indicator used to make sure the side of the vise was parallel to the long side of the table. Then I mounted a long end-mill in the collet chuck and took a very light cut on each jaw to make sure the jaws were parallel and square

with the sides of the vise.

This picture shows the vise mounted on the milling table. I made a clamp from an old piece of angle iron and fastened it to the front of the vise with a short M8 screw. I also had a couple of clamps with a cylindrical end that fit the 8.5mm holes in the side. I can now fasten the vise both lengthwise and crosswise on the milling table.

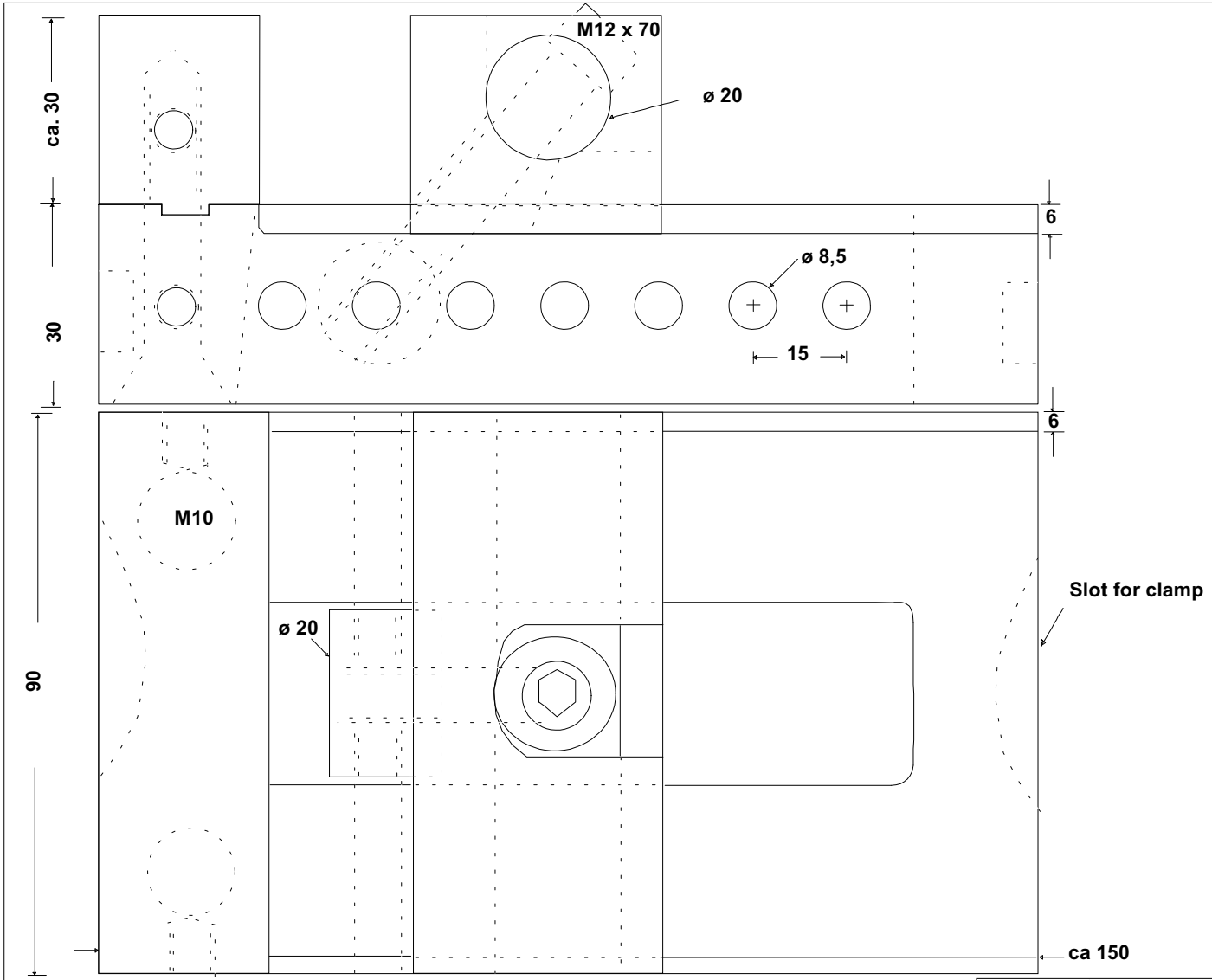
Improvements

After I had finished my screwless vise I found Rick Kruger's pictures of the underside of his screwless vise at Ty's Vault (http://warhammer.mcc.virginia.edu/ty/7x10/vault). These pictures show the mechanism of the crossbar and I decided to modify my vise so I could use a similar crossbar. I made the crossbar from one piece though (similar to Bill Ward's vise at www.wwnet.net/~radix).

First I mounted the vise upside down on the milling table and removed 6 mm from each side of the slot. The depth was about 10 mm so I just opened up the holes from the side. This made the bottom part about 12 mm wider. I then used a 5 mm end-mill to open up to 8.5 mm so the crossbar would fit. Then I used a small rotating file in my Dremel copy for the final finish. I had to regrind my end-mills midway in the milling process, because they got worn and didn't cut well.

The crossbar was made from a piece of silver steel (drill rod). The rod was first faced on both side to give the correct length, and the centres for the two 8 mm protruding parts marked. With the piece mounted in the 4-jaw it was simple to use a centre in the tailstock to line up the marks with the centreline of the lathe and turn the rod down to a little over 8 mm.
The last operation on the crossbar was to drill a 10.2 mm hole and tap it M12.

The bottom picture shows the underside of the vise with the crossbar in place.



Dato:	Tegner	Materiale:	
2003	T.H.	Steel	

"Screwless Vise", Mini-Mill