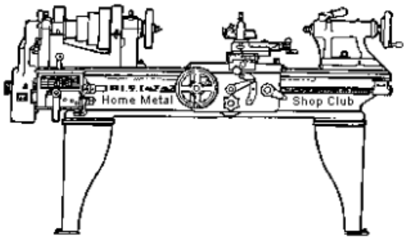
Home Metal Shop Club

January 2010
Newsletter

Volume 15 - Number 1



http://www.homemetalshopclub.org/

Since its founding by John Korman in 1996, The Home Metal Shop Club has brought together metal workers from all over the Southeast Texas area.

Our members' interests include Model Engineering, Casting, Blacksmithing, Gunsmithing, Sheet Metal Fabrication, Robotics, CNC, Welding, Metal Art, and others. Members always like to talk about their craft and shops. Shops range from full machine shops to those limited to a bench vise and hacksaw.

If you like to make things, run metal working machines, or just talk about tools, this is your place. Meetings generally consist of a presentation with Q&A, followed by ***show and tell*** where the members can share their work and experiences.

President	Vice President	Treasurer	Secretary	Librarian
Vance Burns	*John Hoff*	*Emmett Carstens*	*Dick Kostelnicek*	*Dan Harper*
Webmaster	Photographer	CNC SIG	Casting SIG	Novice SIG
Dick Kostelnicek	*Jan Rowland*	*Dennis Cranston*	*Tom Moore*	*Rich Pichler*

About the Upcoming February 13 Meeting

The February general meeting will convene at the Freed-Montrose Library on the second Saturday in February at 2:00 p.m. A business meeting will be held on the same day at 12:30 p.m. Both meetings are one hour later than usual.
See http://www.homemetalshopclub.org/events.html for details and latest updates.

Lee Morin will talk about the Alibre Computer Aided Design (CAD) Program.

Recap of the January 2 Regular Meeting

Thirty-three members and four guests; John Elliott, C. A. Riser, Jim Mason and Daniel Abergal, attended the meeting held at the Freed-Montrose Library. Several members and one guest saw the club's advertisement that was posted on Craig's List by Vance Burns.

The HMSC member's Biographical page is up and running. Sign up and view the contents at the following link: http://www.homemetalshopclub.org/biography/biographies.html

Presentation

Ed Gladkowski showed many of the jigs and fixtures that he's made over many *(not to be enumerated*) years. Most of his creations relate to non-standard operations preformed in the lathe.

Photo 1 shows a tool post drill with a manual quill advance that turns the lathe into a horizontal drill press having a X-Y and tilting table. Ed claims that very straight deep holes require that both the work and drill bit rotate in opposite directions simultaneously. The drill chuck can be replaced with an arbor mounted stone for operation as a tool post grinder.

Photo 2 is of a heavy-duty tool post for square shank bits. Aside from the fine craftsmanship, Ed attributes the pleasing finish to draw filing and Scotch Brite pads.

Photo 3 shows an external ball turner. Note the removable pin used to locate the swivel center under the lathe's turning axis by kissing the point of the tailstock's dead center.

Photo 4 shows the compound slide mounted vertically on a swivel plate. A T-slotted table completes the attachment as a 3-axis + swiveling milling table. An end mill (not shown) is mounted in the lathe's chuck.

Photo 5 depicts a manual slotting attachment that mounts on the cross slide and allows internal keyways to be cut.

Photo 6 shows a spindle locking rotary sine bar that allows indexing any angle and hence an arbitrary number of rotational positions of the lathe's spindle. An explanation of its operation is given in Ed's article **A Rotary Sine Bar for the Lathe** and is avaliable at: http://www.homemetalshopclub.org/news/nov03/nov03.html#rotary

Photo 7 shows a backside lathe cutter. Note the tool bit is upside down. After cutting an internal taper with a boring bar and with the compound set at an angle, the backside cutter is slipped over an external male taper which is cut without resetting the compound's angle to the usual mirror image in the lathe's axis. This ensures a prefect fit of the external male and internal female tapers.

The above are all used in Ed's old but favorite lathe, a 9-inch South Bend.

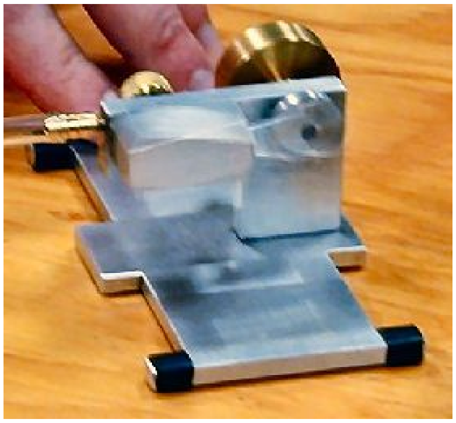
Novice Group

The group continued its study of drill sharpening methods. They compared jobbers and parabolic type drills by noting the variations in web thickness along their lengths. Also observed were differences in the clearance face profiles for drills sharpened with swing and cam operated sharpeners.

Show & Tell

Martin Kennedy showed his latest (*loose change burning a hole in his pocket)* purchase of a set of compact foldable hex keys having a novel ratcheting mechanism.

Joe Williams has replaced the short cross bar handle in a Jacob's chuck key with a long automobile push rod. This provides increasing leverage as one advances along life's path.



Mike Winkler just finished making an oscillating steam engine (left photo). He runs it in a novel way by using the compressed gas from a computer duster can.

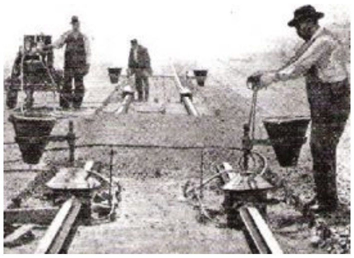
Joe Scott showed a horizontal band saw support stand made from scrap pipe and 2x4s (right photo).

John Hoff related how he made a replacement Acme screw for his recently reconditioned surface grinder. The original screw was bent after a machine mover dropped the grinder (*ouch!).*

Rick Pichler showed his lathe-mounted clamp that holds a Dremel rotary grinder. He recently used it to reface some of his lathe's dead centers.

Kevin Douglas brought along the latest modification of his electric motor-to-drive-shaft clamp. He is building a homemade electric car.

Kent Carter asked for help identifying a tapping head that came along gratis with a used lathe that he just purchased.



Dick Kostelnicek gave a book report on the historical use of Thermit Welding by Ethan Vial, available from Lindsay's Publications http://www.lindsaybks.com/. This is a cast welding technique where large sections of metal are fused together insitu by pouring molten iron from a crucible into a mold surrounding the parts to be connected. Aluminum and rusted iron powder are used in the self-sustaining thermite reaction that produces 4500 degree F. molten iron. The aluminum burns, without the aid of atmospheric oxygen, forming a glass-like slag and reduces the iron oxide (rust) to pure molten metal. Today, continuous rails are still field welded by this process.

Enhanced Arbor Press

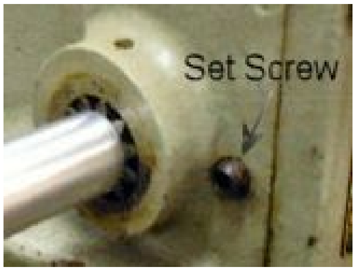
By *Dick Kostelnicek*

My old Drake No 1 arbor press has had several modifications over the years. It is mounted on a sturdy steel weldment stand (red color) with a 4-inch wide half-round table cutout directly beneath the ram. The clearance, provided by the cutout, allows pressed-out parts to clear the stand's tabletop (left photo). A wooden pullout drawer holds various arbors, supports, and punches. It has a carpet remnant (green color) covering its bottom at the drawer's front. With the drawer pulled out, the carpet catches pressed-out parts before they can hit the shop's concrete floor, thereby preventing costly dings and dents.

The stand's bottom shelf holds a set of 33 round transfer punches, ranging from ½ to 1-inch diameter by 64-ths. (above right photo). They serve as the perfect set of driving punches for pushing out bearings and separating other press fitted parts. Each punch has a small pointed protrusion on one end. The point is used to impress a center mark during the transfer of a hole's location. Rather than grind flat each punch face, I've drilled a small countersunk hole in the center of the ram's square bottom face (lower right photo). The mating of a punch's protrusion and the ram's center hole ensure the prefect alignment of ram and punch. When I need a perfectly flat ram face, I just flip the ram end-for-end, as it is symmetrical.

My arbor press did not come with a ratcheting lever bar. This makes pressing and broaching difficult whenever the pull-down bar is not in a convenient position to acquire sufficient leverage. My solution was to extend the pinion gear shaft with a reduced diameter aluminum spacer (photo below). By sliding the pinion shaft assembly fully to the right, the pinion gear disengages from the ram's rack allowing the shaft to be rotated to a new position (next page - left photo). The pinion shaft is then pushed fully leftward, re-engaging the ram's rack. In effect, this is *a poor man's* ratchet.

In order to prevent the ram from falling under its own weight while the pinion gear is disengaged, a small tapped through-hole is located in the left side of the ram's square head alignment bearing. The hole is located at the same height and just forward of the pinion shaft (right photo). A short length of a hard rubber pencil eraser was placed in the hole, backed by a short stout spring, and contained by a setscrew. By tightening the setscrew, the rubber eraser presses against the side of the ram, preventing its free fall.



Another pencil eraser, but without a spring, was placed under the pull-down bar's thumbscrew, located at the extreme right end of the pinion shaft (left photo). The rubber eraser prevents the bar from easily sliding through the large round collar at the right end of the shaft. The eraser's friction allows the pull-down bar to remain centered while the pinion shaft is rapidly spun to acquiring a new ram position.

The MK.1 Eyeball

By *Old and Slow*

Way back when I was young, quick, and working for Uncle Sam, it was a time of darkness.

Nary a LED brightened the land. DROs were unknown and digital meant your fingers and toes.

In this primitive time, we had to do the reoccurring job of machining rough brass castings for large universal joints that looked sort of like big 8-inch diameter bottle caps. They had cross-shaped openings, about 3-inches along the arms, and were cored in the middle of the cross. Both arms were 1-inch wide and had to be finish-machined to size.

After the ODs of the casting rims were trued in a lathe, the crosses were laid out on a surface plate with V-blocks, combination-square, and a surface gage. Height gage? What height gage? Two of these castings would be bolted together as a matched pair and then introduced to the "jumping jack", a vertical shaper-slotter 8 or 9 feet tall with a round 30-inch in diameter table.

Around this time, an occasional but vague and disturbing rumor was being whispered that some *egg-heads* in a benighted location like New England or some such place were experimenting with robot machine tools that were fed a diet of paper tape. The tape had punched holes, sort of like what I used in my cap pistol as a kid. All the *eggheads* had to do was sit around and drink coffee while the machines did their thing. I figured it was just a story, but you never know what those *Yankees* might pull next. I was glad I was working with REAL machines run by REAL men!

Which brings us back to the universal-joint castings on the “jumping jack” because funny thing was, that was a two-man job.

Slotting to the layout lines of the 3-inch cross-shaped openings on that 30-inch machine table meant that the operator had to lean way over just to see the lines, which put his head right under the ram as it danced up and down like a big potato masher. Not a good thing, considering that Uncle Sam had a lot of money invested in us guys. So, we worked in pairs, the operator moving the table feed with the big hand wheel, while the spotter told him how far he was from the line. We’d swap positions every few pieces when our eyes got tired. The thing that amazed me at the time and stays in my mind to this day is how the spotter would call out, “Okay, three more thousandths to the line,” and the operator fed three more thousandths and the line was split.

This became the norm; of course my vision was much better back then. We maintained alignment consistently within the +.005 to -.000 inch slot length tolerance. Granted, not a particularly tight tolerance, but not bad considering the methods we used. Naturally, given whom we were working for, it became known as measurement by “MK.1 Eyeball.”

To this day, more than 40 years on, I still try to *eyeball* things as close as I can. It’s a useful habit that can save time and sometimes prevent gross errors that are so obvious but can still be overlooked. Try it yourself. There is no reason a milling vise can’t be aligned square to the table within 5 or 10 thousandths by eye, before you indicate it. Same with work in the 4-jaw chuck. Those rings that are grooved into the face of many 4-jaws aren’t there for decoration, you know! Many times you can center round stock in the 4-jaw with a piece of chalk or pencil, close enough for finish turning and faster than you could change to a self centering 3-jaw or collet. Please refer to the old textbooks for such techniques. I don’t want to be responsible if you get careless and damage yourself!

In today’s climate of techno-speak jargon, where everything seems designed to impress or sell, what we did back then would now be called EAT-CVA, the Empirical Assessment of Tolerance Compliance by Visual Acuity, or worse! Fact is, it’s just using the ol’ “mark one eyeball” or MK.1.

Making A Model Crankshaft

By *Martin Kennedy*

I'm designing and building a small engine from the old picture shown below. The engine is a Bernay's Twin-Cylinder Steam Engine, first displayed in the Paris Universal Exposition of 1878. You can find more information on it at the web link: http://www.lindsaybks.com/gallery/Jorg/bernays/page2.html.

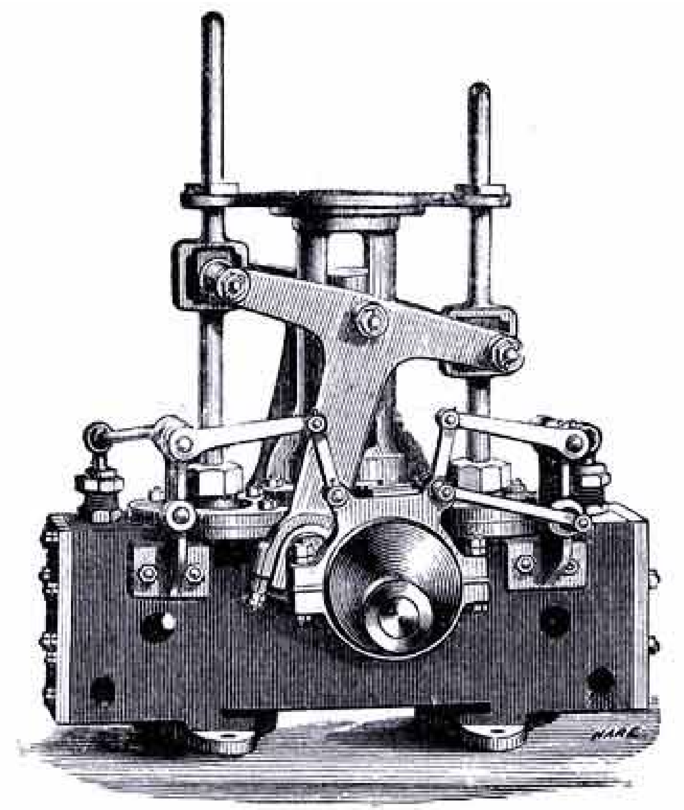
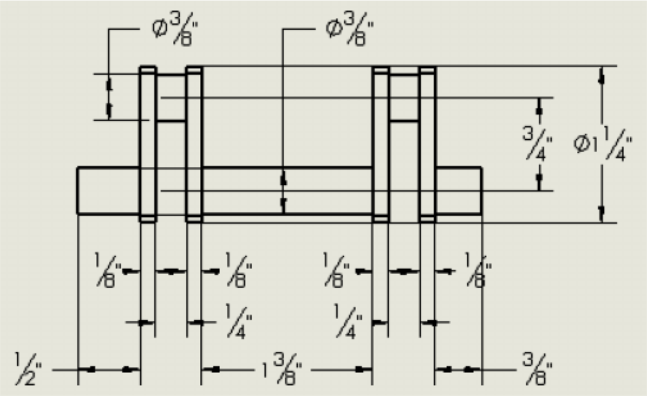


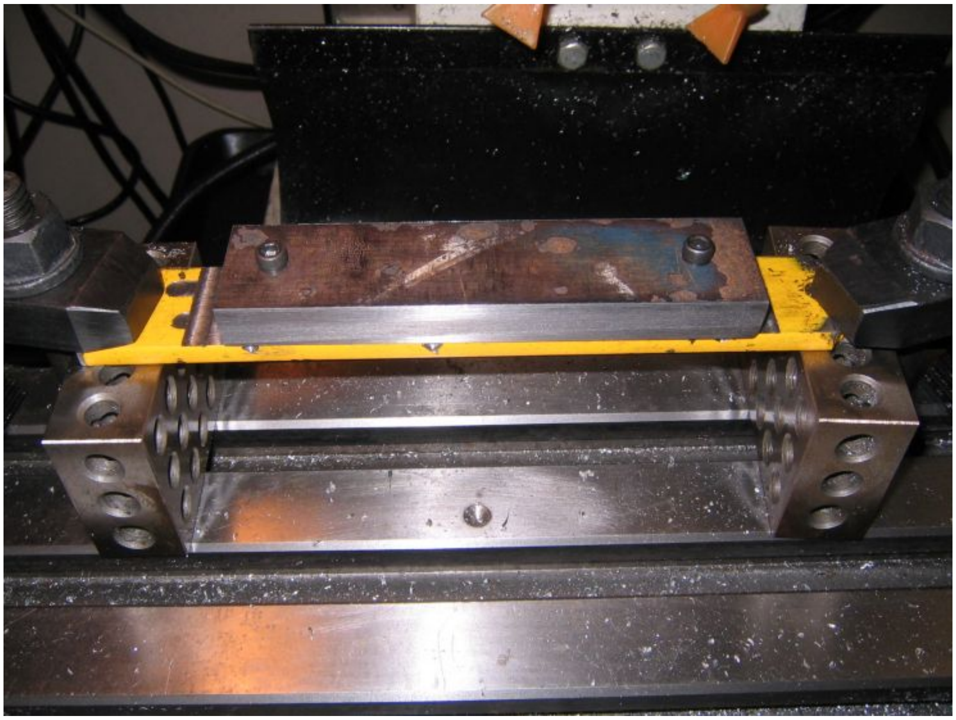
FIG. 10.—*Bernays's twin-cylinder steam-engine.*

I just finished machining the crankshaft. It's unusual in that both crankshaft throws are on the same side. Usually, for dual-double-acting cylinders, the cranks are 90° apart. However, this engine employs a vertical cross head and two oscillating T-shaped plates to pull both cranks around rather than employing the usual inline straight push-pull connecting rod.

One of the challenges to making a crankshaft is that it has multiple axis of rotation. This article shows how I built my crank using a mill and lathe. I've seen designs for built up crankshafts where the different parts are brazed together, but I wanted to make this one from a single piece of metal.

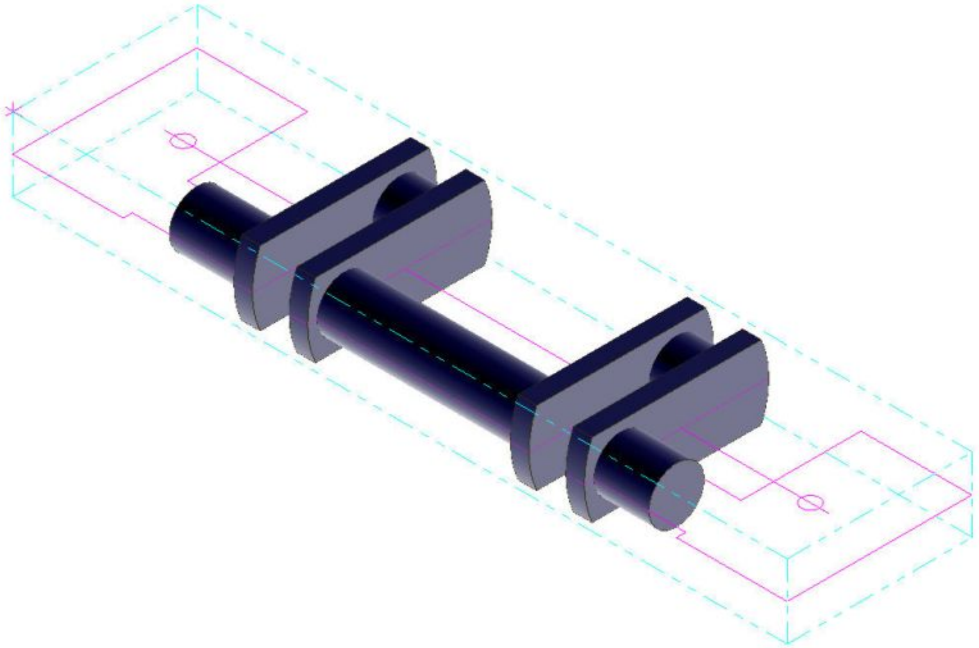
First, let's look at the crankshaft design. A plan sketch and a three dimensional rendering of the crank are shown here.

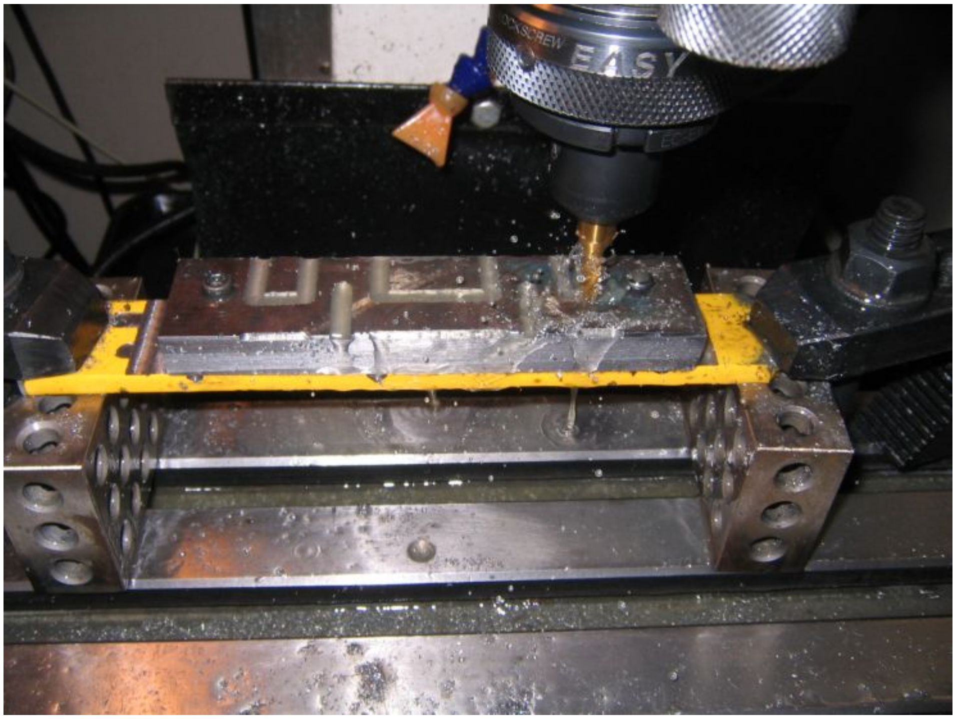




I have a CNC mill, so I used it to rough out the crankshaft from a rectangular piece of ½ - inch mild steel plate. This initial cutout technique reduced the amount of metal I would have had to remove later in the lathe. The photo at the left shows the fixture that I built to hold the stock in the mill. The yellow support plate is a piece of scrap steel that I didn't mind cutting into. I raised the setup with 1-2-3 blocks to protect the milling table from the end mill cutter, just in case I plunged completely through the support plate.

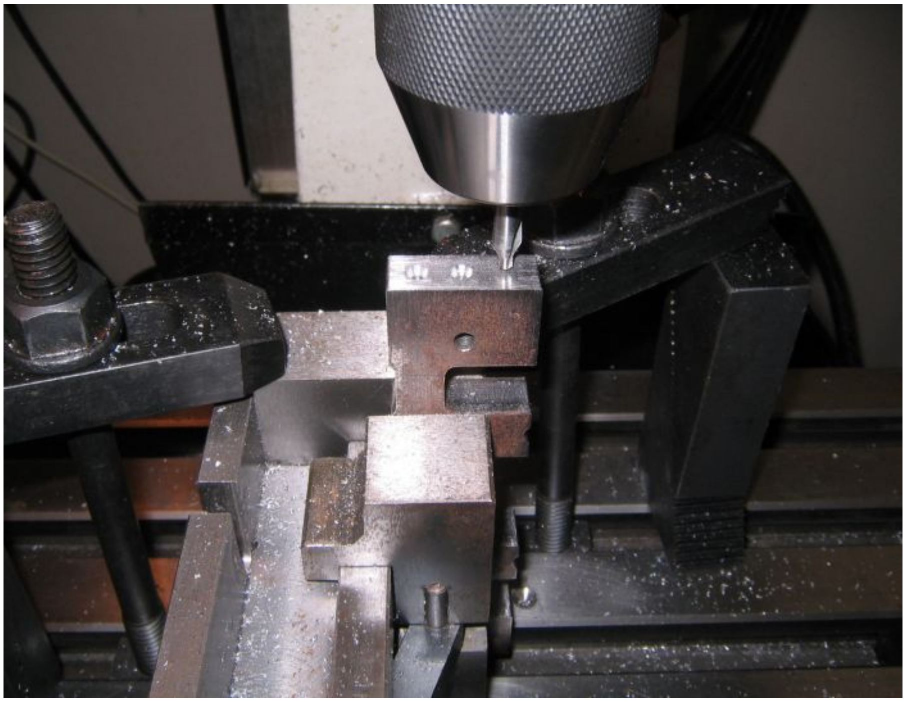
The 3-D drawing below shows a finished crankshaft and the outlines of support tabs that were removed after final turning. The tabs serve two purposes. First, they provide extensions for holding the crank blank to the mill's support plate via two bolt holes. Second, I knew I would need a place to locate three center holes on each end of the plate corresponding to the three lathe turning axis. This will become clear when we see the pictures of the crank's plate mounted in the lathe.





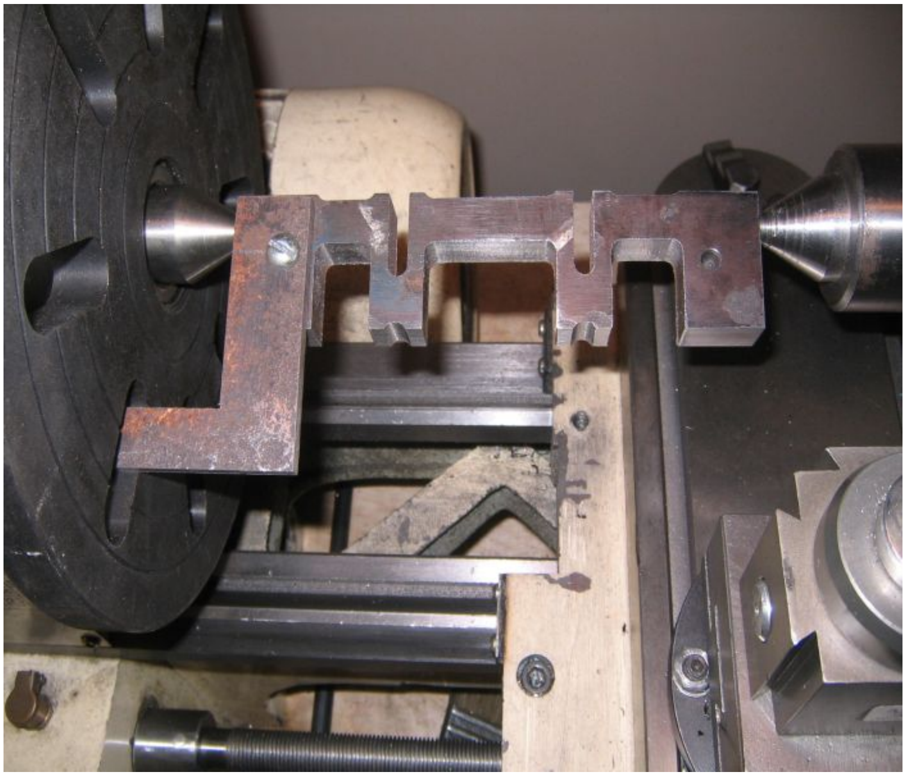
Here, I’ve started to cut into the crank’s blank. You can see the outline of the crankshaft and the support tabs on each end. I’m using flood coolant, since I’m working with steel. I’m cutting just 20 thousandths per pass, so it took 25 passes to cut through the half-inch plate. The CNC program that made these cuts was over 1,500 lines of code, and ran for 1.5 hours.

Now, I’m almost finished. The vertical steel guard plate in the background keeps the coolant and chips from slinging around the shop.

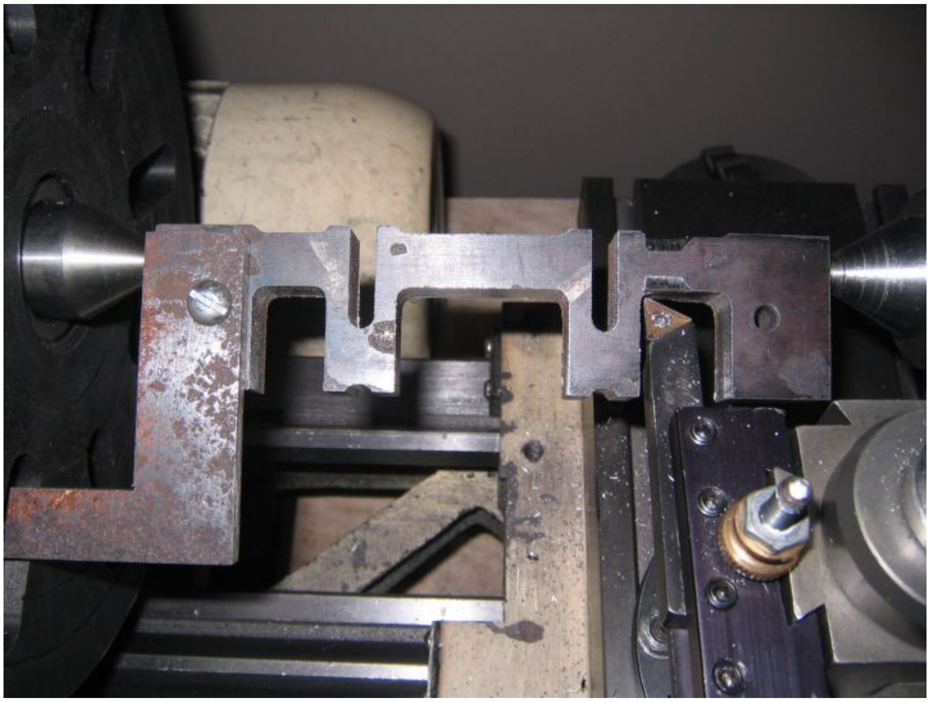


I'm center drilling three holes in each tab end. The holes need to be exactly in the right places. Measure carefully! The clamping fixture is my mill's vise turned on its side. I originally held the work in the vice mounted in its normal horizontal position, but I noticed that the stock was flexing and thereby not drilling in the right place. Turning the vise onto its side allowed me to clamp the part closer to the jaw's top.

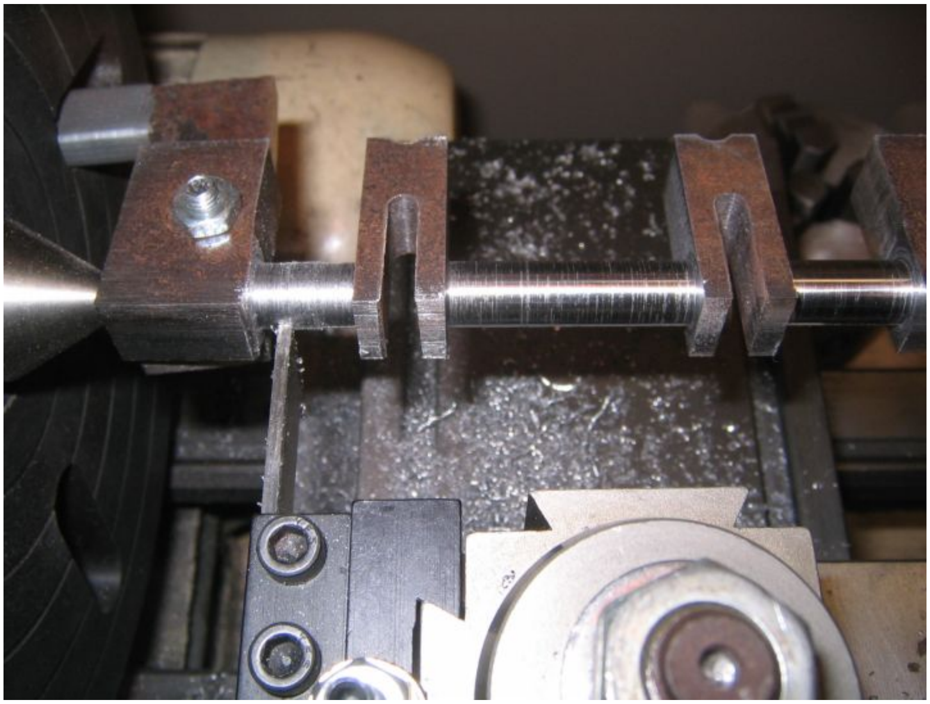
Now I'm ready to put the part into the lathe. Check the alignment of the tailstock's center before you begin. Turning between centers instead of using a chuck makes it easy to mount and remount the part very accurately. I'm using a homemade lathe dog, bolted through the tab's milling hold-down hole. You'll see in a later picture that I wrapped the end of the lathe dog with duct tape to eliminate the clanking from the interrupted lathe cuts.



You should tighten the center on the tailstock just until it's snug. Due to its serpentine shape, the crank's metal blank becomes slightly *springy*. It'll get *springier* as I continue to remove metal. If you clamp down hard with the tailstock's ram, you'll flex the part, and it won't turn true. You might use removable brace blocks between the gaps in the crank's throws so that you can clamp tighter. I decided to make this crankshaft without the braces. If it were any smaller than having a 3/8 - inch shaft, I would use braces.

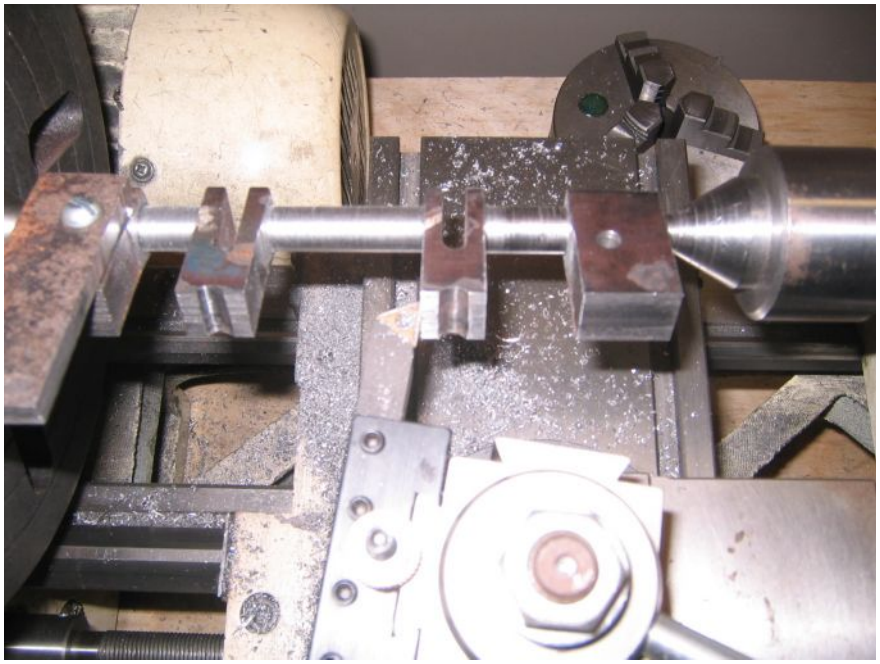


Before you start turning, familiarize yourself with all the protrusions that can grab fingers. When you cut a smooth round piece, bumping into spinning metal with your hands most likely won't cause any harm. Not so with this piece! There's plenty of room for fingers between the tool, tool holder, and jagged work piece. Watch out! Another potential danger is the lathe dog. A dangerous situation occurs near the dog and faceplate. At the far left, the tool bit and dog behave like a pair of scissors. Maintain a healthy respect for spinning metal objects.



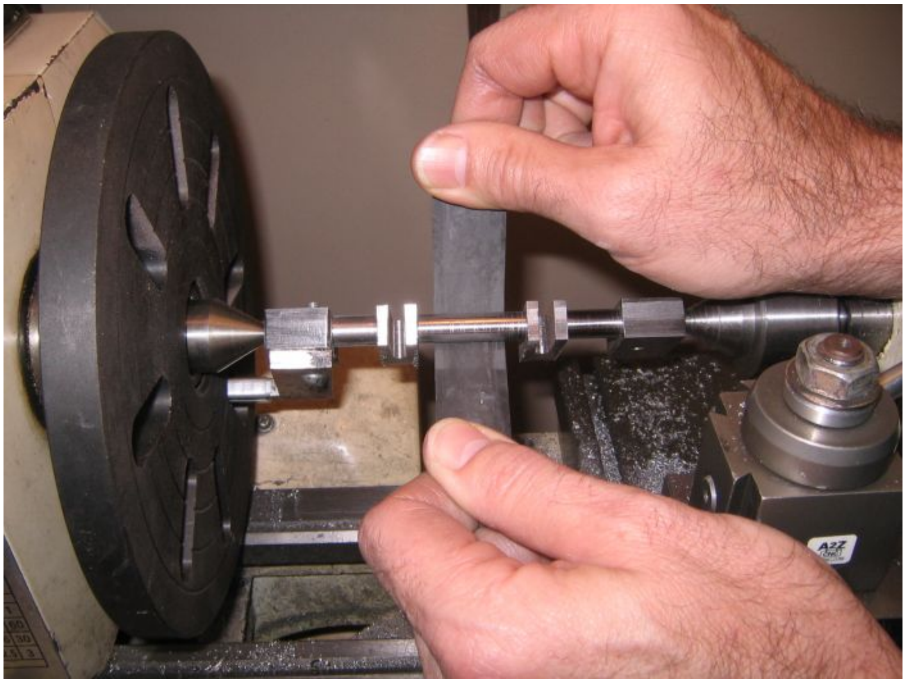
Here, I'm making the first main shaft cut. Since the gap is small, I'll have to use the right hand, left hand, and 60° cutting tools to get all of the metal.

Now, I'm nearly finished with the main shaft. When I get within 5 thousandths of finished diameter, I like to make fine passes using my thin cut-off tool and the automatic carriage feed. The cutoff blade is a bit flexible when used like this, so I take very light cuts, about ½ to 1 thousandths inch. The cutoff blade allows me to get into those narrow places that I can't easily reach with regular bits and tool holders, especially between the crank's throws.



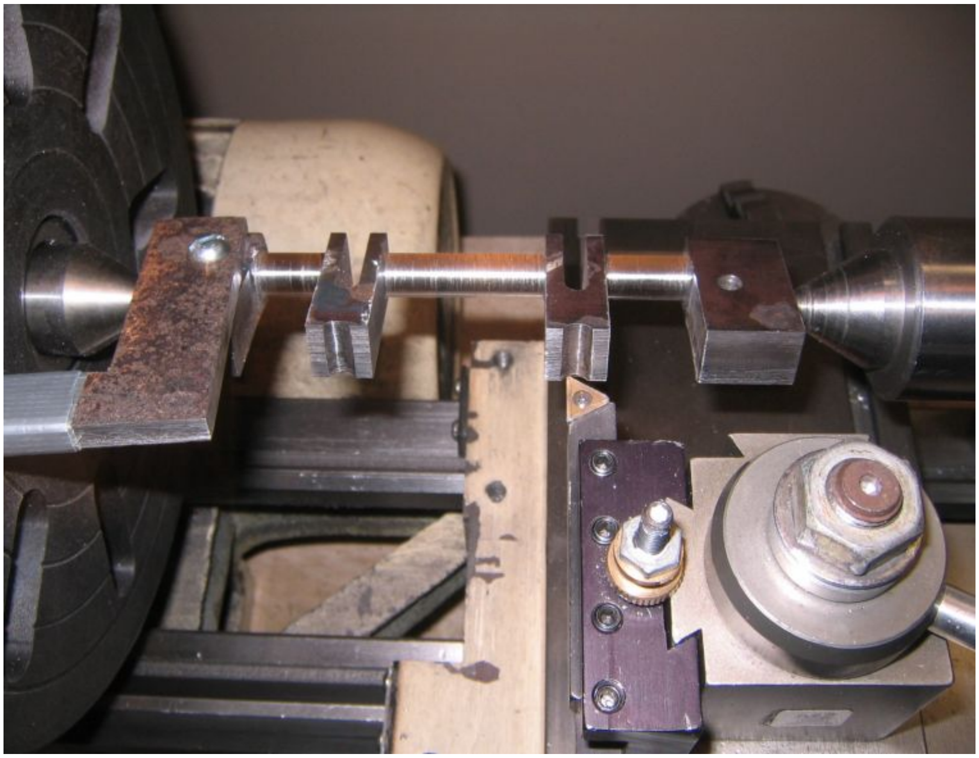
Once the main shaft is finished, you can machine the sides of the crankshaft's throws. Lock the saddle and use the slightly angled compound feed screw to make light cuts. I take off about 5 thousandths per pass. I like to set the tool at about a 5° or 10° from perpendicular when I make a facing cuts. If you put the cutter's side face flush against the work, it makes a taper cut due to lack of clearance. The root of the cut will be about 10 or 15 thousandths thicker than the outer end.

To make these cuts, I monitored the thickness of the throws. I wanted them to be ½ - inch thick. The critical dimension, however, is the 1-3/8 - inch dimension between the throws, as there is a bearing at this location. I just made sure I attained that dimension first, and took any excess thickness off the outsides of the throws.

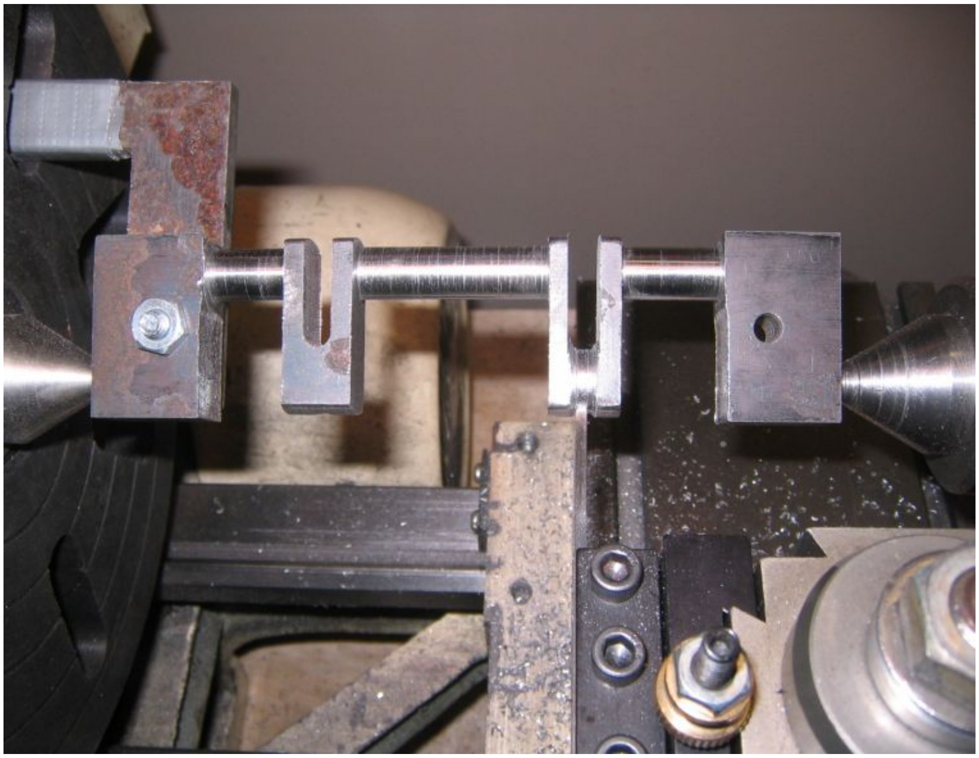


I'm nearly finished with the main shaft. I like to polish the parts and get a smooth finish. I started with 150 grit emery paper. I spent the longest time with this grit and then worked quickly through 240, 320, 400 and finished with 600. Cover the ways of the lathe with a damp cloth to catch the abrasive dust. When you finish, vacuum everything and then wipe down the lathe's ways before moving the saddle or cross slide.

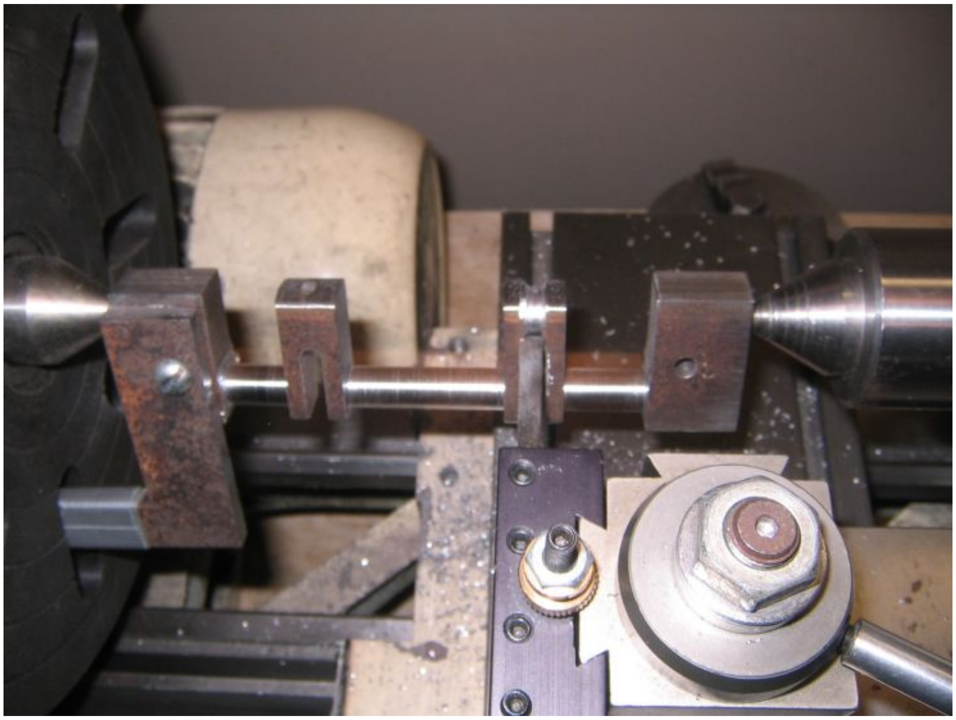
Use extreme caution! Remember the above discussion about pinch points. The emery paper will sometimes catch on something and wrap around the work, so be sure to keep your fingers far enough away so they don't get dragged into the spinning mass! I noticed in this staged photo that if the lathe were turning, the part would hit me at the base of my thumb. So be extra careful!



The next step is to move the centers to the middle set of countersunk holes. This is a quick step since all I need to do is round over the outside ends of the throws. Since this is an extreme interrupted cut, take fine cuts!

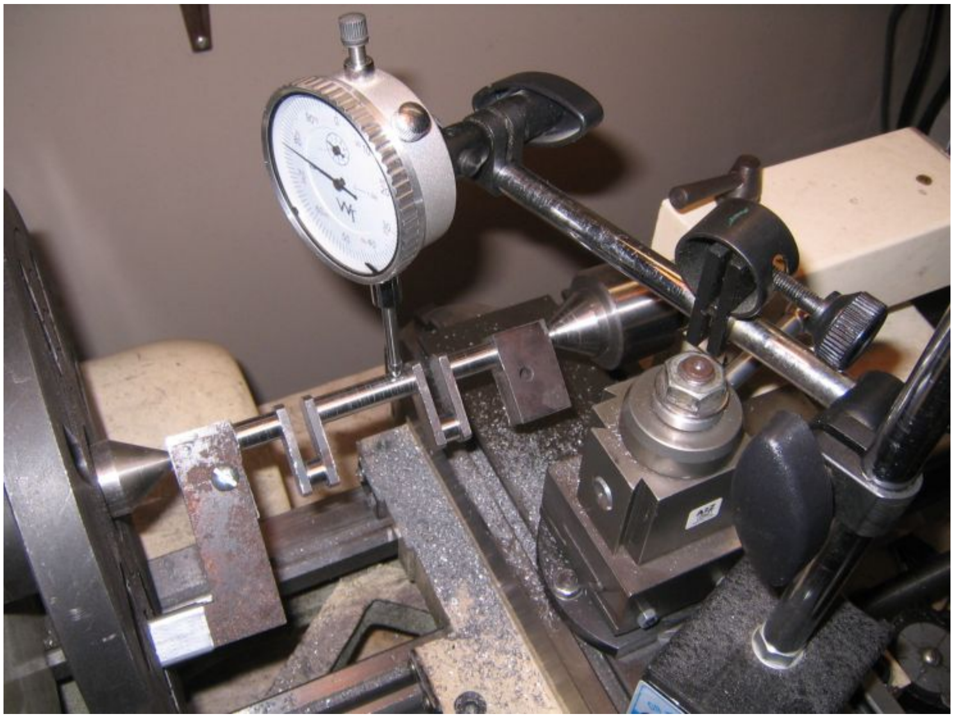


Next I move the centers to the last set of holes. I'm ready to do the hardest part – machine the very short throw shafts and the inside faces of the throws. In this design, the throw gap is only ¼ - inch wide. On the mill I used a 3/16 - inch end mill to rough out the gap. Here I'm using a cut-off blade, and a 5/32 - inch piece of tool steel to work the throw shaft down to the right dimension.



I used a 5/32 - inch square tool steel bit to face the insides of the throws. I started making 90° cuts, and then put a slight angle into the bit as before. I rotated the part by hand each time I increased the angle to make sure it cleared the other side of the offset before powering the lathe.

It's tempting to use a ¼ - inch tool steel bit to make this cut. Bad idea. It will cut both sides, but since the part is very flimsy now, it grabs easily and bends the part. Personal experience... When the crankshaft is nearly complete, it's very easy to bend. You can tighten the tailstock too much, or just have a cutting tool grab while turning the part. I'll talk about how to fix bends later. A few times while turning this part, I remounted it on the main shaft countersinks to see if it's still ran true.

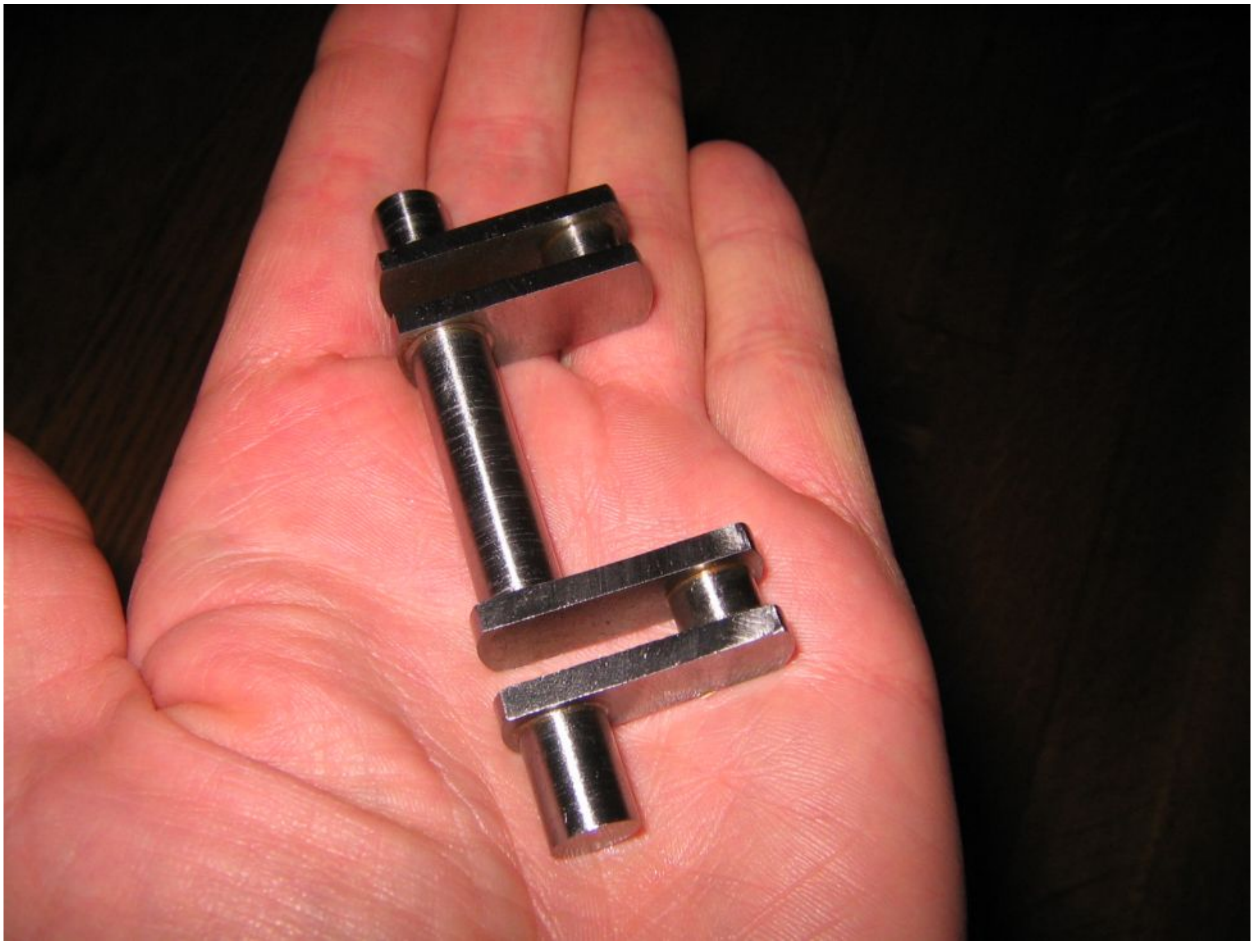


At some point during these operations, you're likely to have to fix a bent shaft. Here's how I do it. Put a dial indicator on the main shaft. Rotate the shaft by hand. Find the high spot. Tap on the high side using a hammer and a piece of wood to prevent dings. You don't have to hit very hard. Loosen and then snug up the tailstock. Repeat.

First, work the bend that lies in the plane of the throws and main shaft. Then move on to any remaining bend located in the perpendicular plane. Measure the run-out, tap the high side, measure again and repeat the process till you attain zero run-out. Rotate the crank 90 and do it all over again, Continue until the shaft is perfectly straight.

I’ve had bends over 0.1- inch at the shaft center and I’ve fixed them to within 1 thousandth using this technique. Typical bends are on the order of just 50 thousandths run-out.

All I have to do is to cut off the two end tabs, face the shaft ends, remove any burs, and finish polish the crank.



I’m done! Here’s what the completed crankshaft looks like.