100% Homemade Lathe

by catwood on August 3, 2007

Table of Contents

intro: 100% Homemade Lathe

Although I know other people have built lathes themselves, after an enormous amount of looking on Google, I saw most homemade lathes involve casting and milling, as well as using off the shelf components like chucks and tapers. Being only a high school student, I wanted to experiment with a lathe without having to spend hundreds of dollars that I don't have. I ended up using almost all scrap materials from my basement, so there is no need to follow my materials choices. Because your design choices will vary, this article is more of a record of how I built this one, rather than a manual for building yours.

I managed to build this lathe in about a week, with not much more than a cordless drill, a drill press, a jigsaw, and assorted hand tools. I hope that I have documented my project here in an understandable way.

Warning: This is a powerful device designed to spin stuff quickly. I take no responsibility for anything you do. Don't try this unless you have at least a little bit of experience with tools. And wear safety glasses when using it because particles fly around.

step 1: Decisions

So, if you are reading this, you must be interested in building a homemade lathe. First, I would advise you to look at the diagram in the [http://en.wikipedia.org/wiki/Lathe_(tool) Wikipedia article] to learn the basic parts of a lathe.

The first thing you have to decide is what kind of lathe you want. Either to work with metal or wood. A wood lathe requires a less powerful motor and not as close tolerances. Also a wood lathe does not need the complicated tool rest that a metal lathe has. For the first version of my lathe, I decided to just stick with wood and see if I could come up with something that actually worked.

The next thing to decide is size. I would highly recommend not going too overboard... tree size logs on a wood lathe and 50 pound steel bars on a metal lathe are best left to professionals I think. I decided to try to make a wood lathe for pieces up to 4 inches in diameter and about 30 inches long, although I will not be trying something that big until I get more practice with small items, like tops, chess pieces, other little toys. But I figured that I had a pretty powerful motor sitting around, so I might as well make it big enough to handle large salt shakers and chair legs so in the future I could do large things.

step 2: The Bed

As you can see in the diagram mentioned in the previous step, the bed is kind of the frame of the lathe. Since I wanted to be able to handle pieces up to 30 inches long, I need 30 inches between the headstock and tailstock (reminder: see [http://en.wikipedia.org/wiki/Lathe_(tool) diagram]). I figured I needed about 8 inches for the headstock (basically a pulley for power from motor, supports, and a chuck to hold the work) and 4 inches for the tailstock (supports work on the other end), so I figured the bed should be about 40 inches long.

The bed needs to be very solid and not flexible or the material will wiggle all over as you are trying to work with it. I had an 8 foot long piece of 1/8" thick aluminum angle, 1.5" x 1.5". Out of the 96", I cut two 40" pieces for the main rails. This design turned out to be slightly more wiggly than I had hoped, maybe for the second version I will use steel.

The picture shows the two pieces on a stool in the orientation they will be in.

step 3: Bed Construction

I laid the two pieces back to back and lined them up very carefully. It is crucial that the tops of the two pieces are level and lined up. As in the picture, I used a strip of UHMW on each end to separate the two aluminum pieces 3/8". This enables me to be able to use 3/8" diameter bolts to hold down the headstock and tailstock to the lathe bed. I used three smaller bolts rather than one large bolt through each piece of UHMW to prevent rotating.

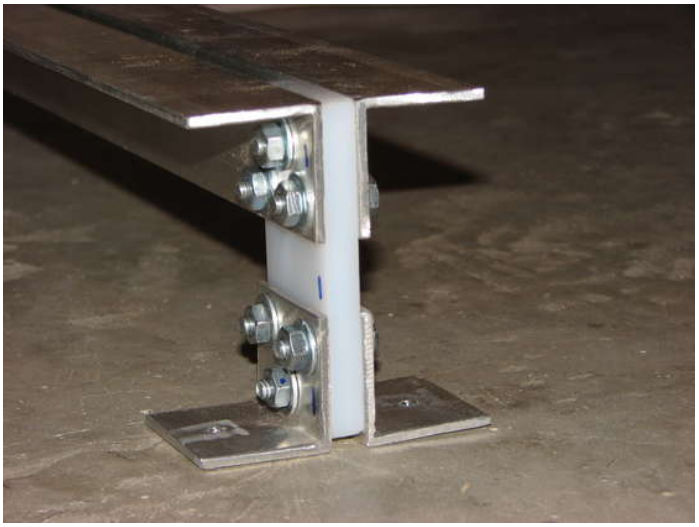
I numbered each intersection of the base in case I ever need to take it apart, it would be easier to put back together.

The first picture is a close-up of one of the two UHMW pieces on the end. The second photo shows the bed being stood up by a clamp.

step 4: Feet

These pieces are basically feet, but act as brackets to secure the bed of the lathe to whatever larger surface you will attach it to. I cut four 2" long pieces of the angle that I used for the bed of the lathe, and faced them in opposite directions in pairs as shown in the photo. The pieces are attached with the same bolt configuration as the longer pieces.

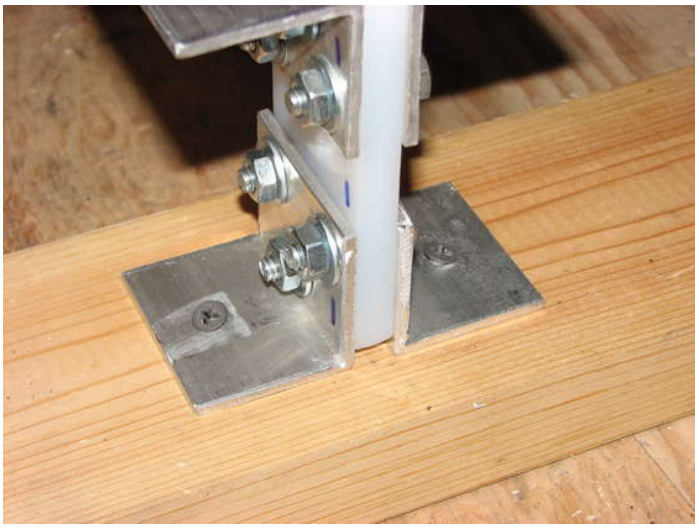
The first photo is a close-up of one end. The second photo is the whole bed standing up by itself!



step 5: Mounting the Bed

I mounted the bed of the lathe now to make it less tippy. There are basically two options: mount it permanently onto a workbench, or mount it onto something else so it can be stowed away when not in use. I mounted it onto two pieces of 2"x4" that I cut to the depth of the workbench so I could put it away if I needed the workbench. I screwed one wood screw through each foot into the 2"x4", and that seemed to make it sturdy enough.

The first photo is a picture of the bed mounted on top of my workbench. The second photo is a closeup of the feet mounted to the wood.



step 6: Tailstock Slide Pieces

I went ahead and made this piece now because it would allow me to tell whether the whole base was actually straight and smooth enough to continue using. It should slide easily, while not having more than 1/16 wiggle room in any direction. I took smaller aluminum angle (1" x 1" with 1/8" walls) and cut two pieces 4 inches long. I had a strip of 3/4" thick UHMW that was 2" wide left over from another project, so i just used two pieces. UHMW is a good material for this piece because it slides easily on the aluminum bed of the lathe. The total width of my base is two pieces of 1.5" angle and the 3/8" space, so i cut the strips exactly 3 and 3/8" long.

The photo shows the pieces assembled, which is covered in the next step, but I did not want to take it apart again for a photo.

step 7: Tailstock Base Assembly

To assemble, I simply clamped the four pieces to the base and drilled through the angle into the UHMW with a small bit. I enlarged the holes in the angle to 1/4" and tapped the UHMW with a 1/4-20 thread. Screws through the alumnium into the UHMW hold it together. Now you need to test the sliding ability of it. Do not give up immediately if it doesn't slide. I achieved an acceptable balance of slide/friction with the screws loosened by one turn to enable it to move when I push it with moderate force (you won't need to move it all that much). Congratulations, you now have a very small monorail!

I drilled 4 holes into the top of the UHMW, all lined up very precisely with the gap between the rails. The one on each end are 3/8" diameter, to allow a bolt to accurately travel through the gap between the rails with a nut underneath for clamping the tailstock down to the bed.

The first picture shows it on the end of the lathe to show how it should fit the track upon completion. The second picture shows it right after assembly. The last photo shows your monorail in action!

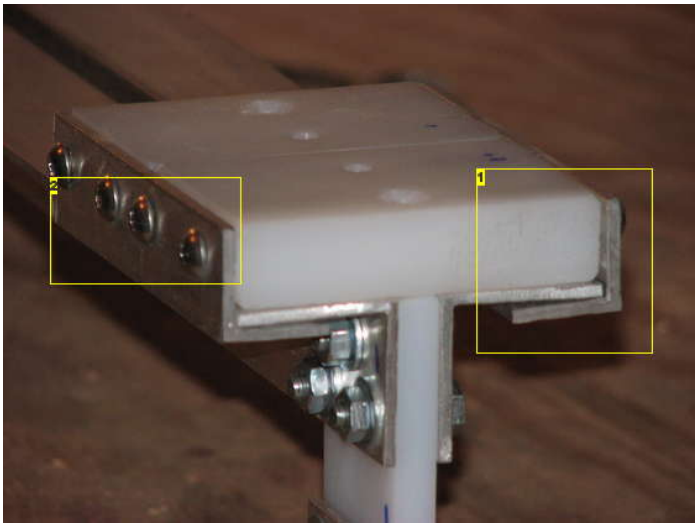
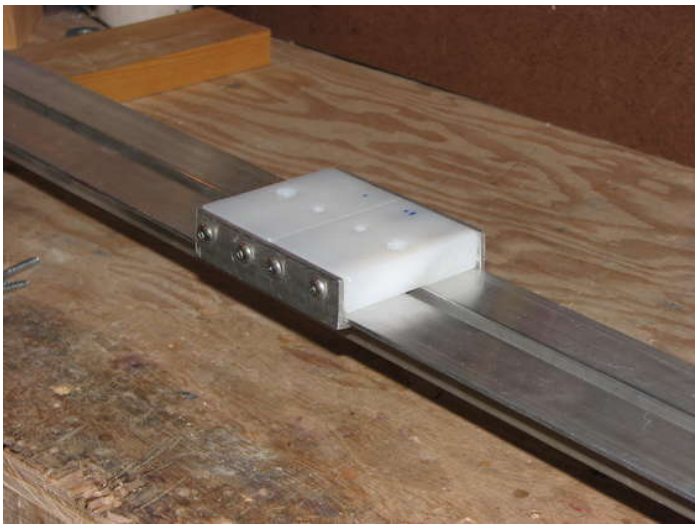


Image Notes
1. This side doesn't fit quite as well onto the bed as the other side, but it works ok.
2. Screws through the aluminum angle into the UHMW.



step 8: Headstock Basics

Because I was not sure about the height that the spindle would be, I did not want to construct anymore of the tailstock yet, so I started on the headstock. The general idea is to support a spinning shaft which has both the pulley and the chuck on it. I decided to use two UHMW supports, so I drilled a 3/8" hole near the top of each for the main shaft. (I decided to make the main shaft 3/8" because I had lots of 3/8" shaft and hardware around). Directly underneath the hole, I embedded a 3/8" threaded rod. This rod will go through the bed and be secured with a nut from the bottom.

I made two of the supports. The height of the main shaft above the bed determines the diameter of work that can be done on the lathe, so i added more UHMW pieces beneath the shaft supports to raise the height of the actual supports. (whew lots of supports, but just look at the second picture in this step). I then tightened the nuts on the bottom fairly tight to secure the two supports about 7 inches apart.

The first picture shows one of the completed supports. The second picture shows the supports mounted to the bed of the lathe.

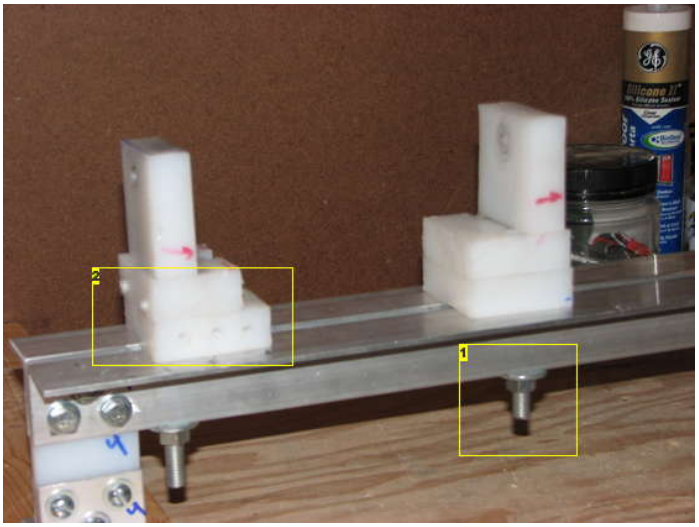


Image Notes
1. Tightening from underneath secures the shaft supports.
2. Spacers to raise the height of the actual supports.

step 9: Headstock Alignment

Next I aligned the two supports I created. I pushed a long threaded rod through both of the supports, and fiddled until the rod lined up perfectly with the bed. I had to remake the supports several times until I got the shaft to line up nicely, but it is worth a little extra work to have a well aligned shaft. When you are happy with the alignment, tighten down the supports extremely tightly because they wont be moving.

The photo shows the shaft pretty well aligned with the bed.

step 10: Securing the Shaft

Now that the supports are tightened down, I secured the shaft in its place to prevent it from moving left or right as different pressures are applied to the workpiece. I started by putting three greased washers against each of the support pieces. Then I locked two nuts against the washers, so that both of the support pieces press slightly away from each other. The double nuts help to prevent loosening as the shaft is spinning. When both sets of nuts are in, any back and forth play should be eliminated in the shaft. Looking at the picture will make it clearer.

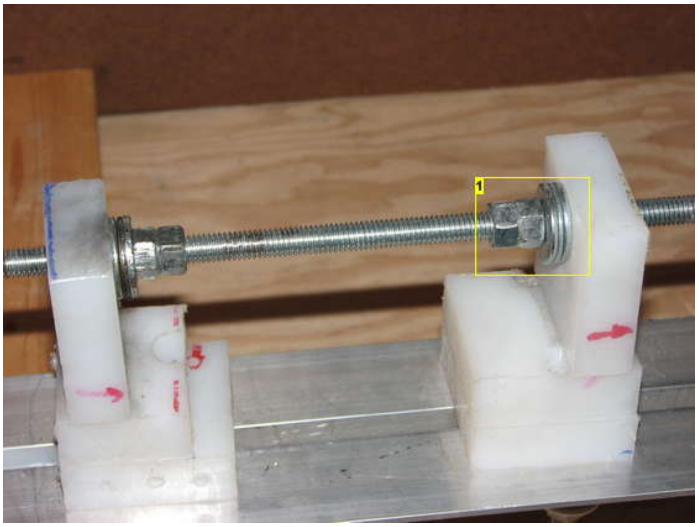


Image Notes
1. Two nuts are tightened against the greased washers.

step 11: Mounting the Motor

I will not go into excessive detail here because everyone's motor setup will vary. The main thing is to make sure your motor can spin with both a lot of speed and a lot of power. For a wood lathe, a 1/2 horsepower motor should be enough. Mine is a 10 pound, 1.25 horsepower motor and it has never slowed down while I am turning something. I decided to use this motor because I had the motor and a fully variable speed controller just sitting around.

I secured a large aluminum plate to one of the shaft supports and mounted the motor to the plate. Before mounting the motor, you should take into consideration the length of the belt you will use to transfer the power. When the motor is mounted, the shaft of the motor and the main lathe shaft should be parallel. An alternative would be to mount the motor to the 2"x4" base, which would take the weight of the motor off of the lathe bed.

The picture shows the motor mounted.

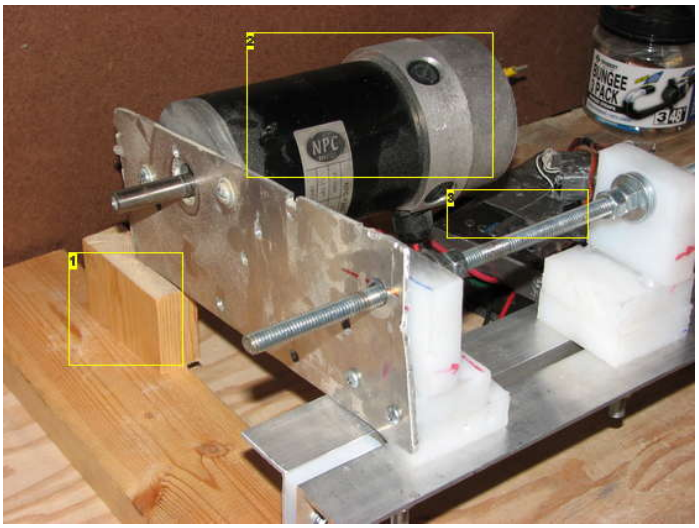


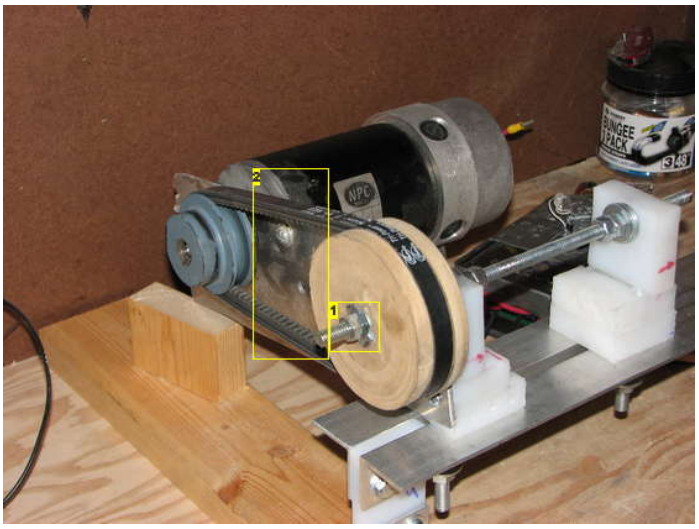
Image Notes
1. Scrap of wood to support the weight of the 10 pound motor.
2. Motor.
3. Motor controller in back.

step 12: Power Transmission

Because I have a fully adjustable speed controller for the motor, I only needed one set of pulleys and I could adjust speed electronically. However, if you only have an on/off motor, a set of cone pulleys would be a good investment so you can adjust the speed by simply changing the pulley ratio.

The gray colored iron pulley on the motor I had kicking around, but I needed a pulley for the lathe shaft. I made one by cutting three circles out of MDF and gluing them together. I found these pretty awesome pieces at Home Depot called tee nuts (see third picture). These are basically threaded inserts for wood, so I imbedded one of these into the center of the pulley. Once I had the two pulleys properly aligned, I tightened the setscrew on the iron pulley to secure it. Because of the tee nut, the wooden pulley acts like a nut, so to secure it in position, I simply tightened another nut against it.

The first two pictures are two views of the completed belt drive. The third picture is a tee nut.



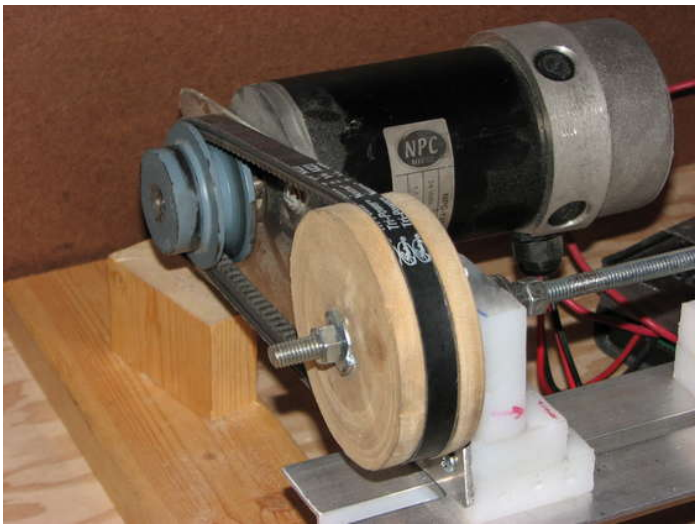


Image Notes
1. Nut tightened against pulley.
2. Suprisingly good tension on the belt!

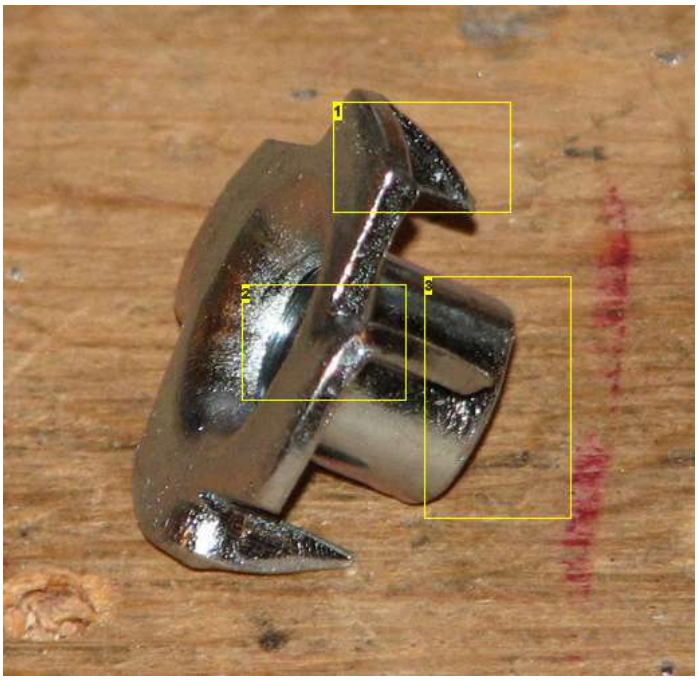


Image Notes
1. Sharp prongs dig into the wood.
2. Threads inside.
3. This shaft goes into the hole in the middle of the pulley.

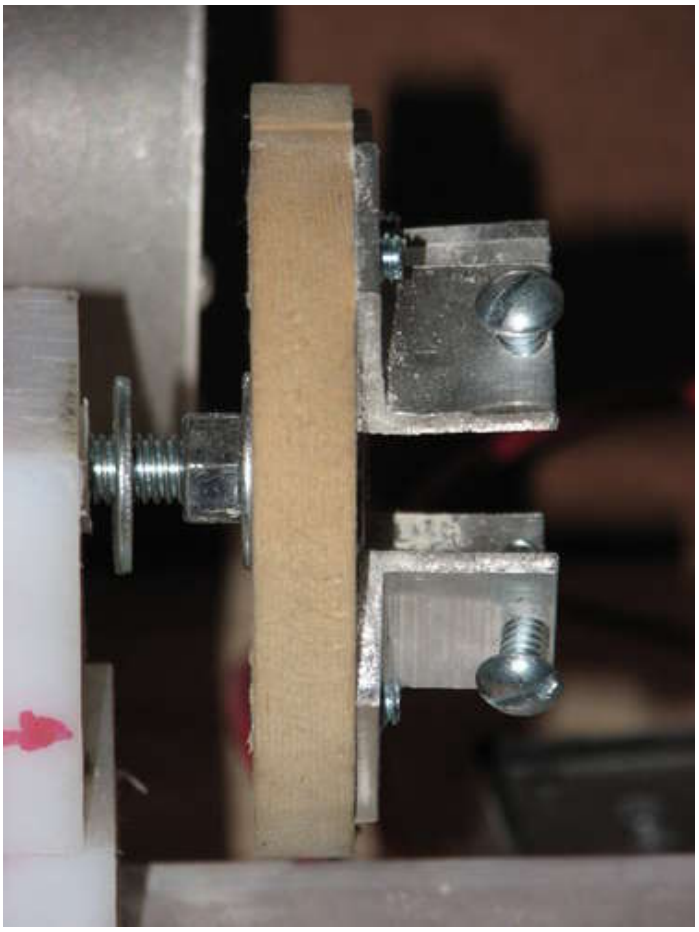
step 13: Chuck Construction

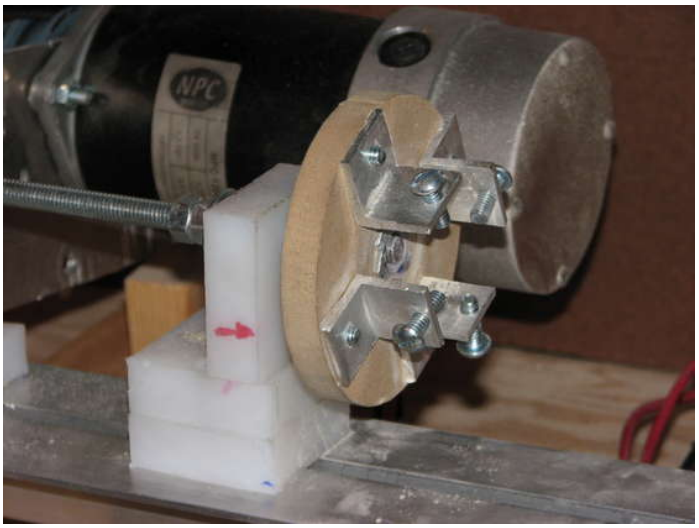
Because I like to do things the hard way, I made a chuck from scratch instead of buying one from Amazon. This chuck looks like a really nice one, but I couldn't justify the $170 dollars when I thought I could do it for under $2.

The basic idea of the chuck is to hold the work. I chose to make a 4 jaw chuck because I can hold square things as well as round things. I started by cutting a 5" circle out of some thick MDF to the best of my ability with a jigsaw and then drilled a hole in the middle. I fitted the hole in the middle with a tee nut. Using the same method as the pulley, I threaded this piece onto the shaft and secured it with a nut. Using a very steady file and a moderate speed, I smoothed out the edge of the disc to make it uniform. By holding a pencil up to the disc, you can draw circles on the disc, so I made one near the outside edge.

Next I drilled and tapped carefully lined up holes in aluminum angle. I secured the four pieces of angle evenly spaced around the circle I drew. Through the other hole in each piece of angle, I put a screw. Look at the first photo to see the completed chuck. Basically a piece of wood can be secured in the center of the four jaws by uniformly tightening the four screw, kind of like a Christmas tree stand.

The first picture shows the finished chuck. The second picture shows a side view to show how the shaft needs to end inside the chuck. The third view shows the mounted chuck from an angle.

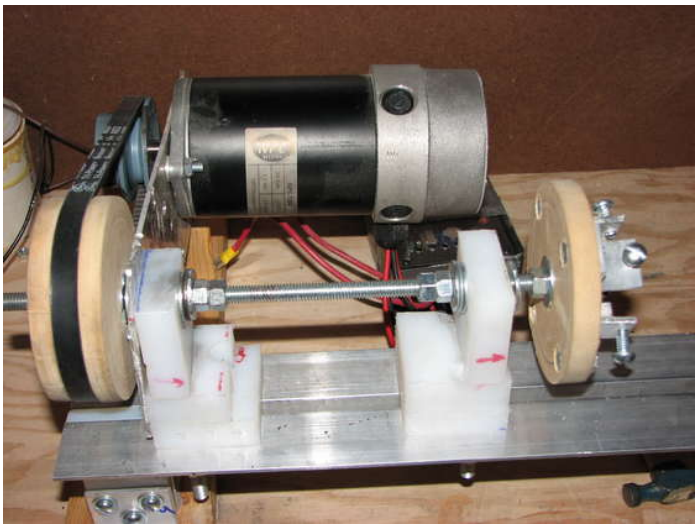




step 14: Headstock Testing

At this point, you should be able to turn on the motor and have the chuck spin reliably. Start at a low speed and ensure the chuck is balanced and that everything is secure. Now is a better time to find any problems with things before you start spinning chunks of wood.

The photo shows the completed headstock.



step 15: Tailstock Finishing

It is a good idea to use the finished headstock to help finish the tailstock. I removed the chuck, so the end of the shaft was now exposed again. On the tailstock, I mounted two pieces of UHMW vertically. Two pieces because they should keep whatever tailstock accessory aligned better than just one piece.

I tightened the tailstock down so it was just barely movable, but not wiggly. By pushing the tailstock against the headstock while the empty shaft is spinning, I made an imprint of exactly where the hole should be drilled so it lines up with the headstock shaft. Then I used the drill press to drill the hole precisely, but accidently drilled the holes 5/8" instead of 1/2" so I fitted some bronze bushings into the holes to reduce the diameter. Double check that the main lathe shaft is correctly lined up with the new holes, and then reattach the chuck to the shaft.

The picture shows the completed tailstock.

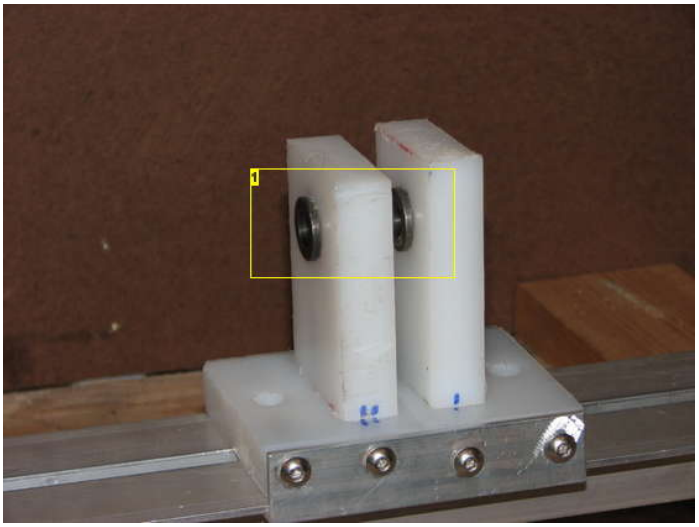


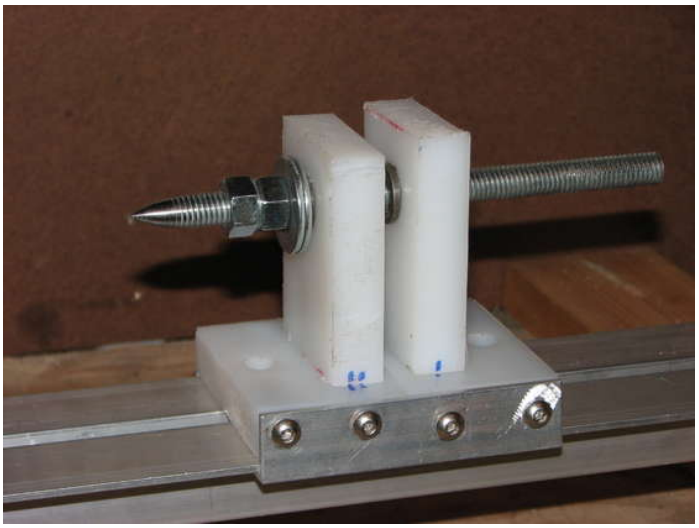
Image Notes
1. Holes line up!

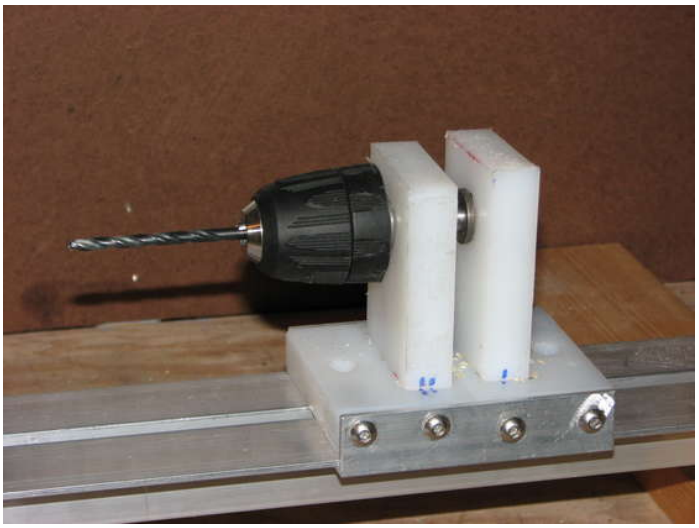
step 16: Tailstock Accessories

The first thing I made was a center to support the work. Originally it was supposed to be a live center, but its too heavy or too much friction to rotate easily, so it is actually a dead center, but works pretty well still. I took a 1/2" diameter (to match the hole in the tailstock) threaded rod and stuck it in my drill press. After a few minutes with a file and sandpaper, it was sharpened to a deadly point.

I had a broken cordless drill kicking around, so I took it apart to see if I could get the chuck out of it. Lucky for me, it had a 1/2" diameter shaft too, so I now have a chuck to hold drill bits and accessories in.

The first photo is of the dead center in the tailstock. The second photo is the cordless drill chuck in the tailstock.



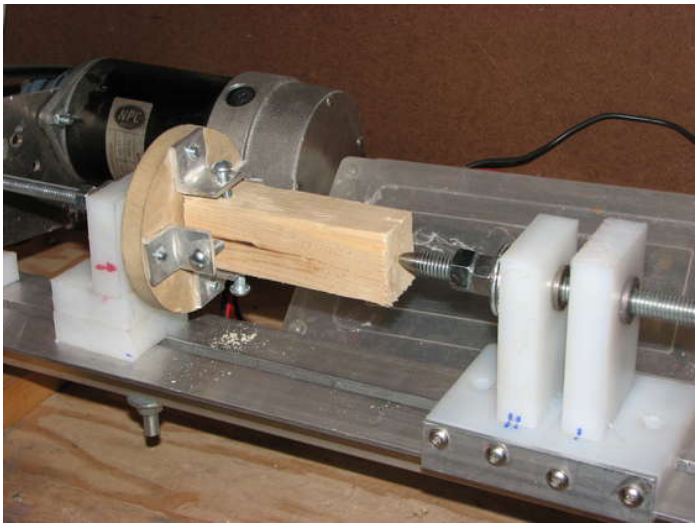


step 17: First Tests

For the first pieces, I decided to try making tops. I started with a piece of pine 2"x2" about 5 inches long. I tightened it in very tight (the screws on the chuck need to dig into the wood to hold it well), and supported it by the center. After roughing out the circular shape from the square wood, I removed the center and shaped that end into a point. Then I shaped the shaft and lightly sanded before cutting it off from the chunk still in the chuck.

After a few tops, I tried to make a chess king, but after the crown broke off, it became a queen. I made this in a similar way; supporting both ends of the piece until the rough shaping was completed, then sanding.

The first picture shows the wood blank ready to go. The second picture shows the queen being carved. The third picture shows the remains after the queen is done. The last picture is 3 of the 4 tops and the chess queen (my dog ate one of the tops).



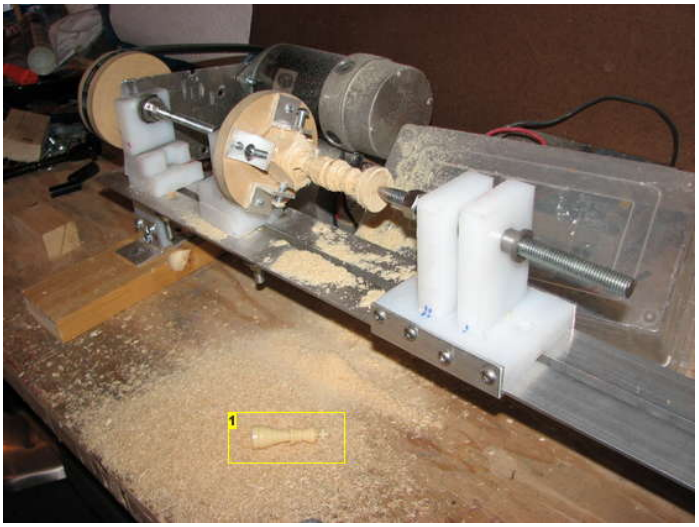


Image Notes
1. Plastic piece for inspiration

step 18: Conclusion

In conclusion, it is definitely possible to build a fairly accurate lathe from scrap materials, for not too much money. In fact I spent a grand total of $0, yes $0. Everything was scrounged from my basement. I expect that someone could build a similar lathe for around $100, most of that cost being a good motor.

Most of the design specifications were met. Because the headstock and tailstock are bigger than I originally planned, there is only about 24 inches between the chuck and the center, but that is still a respectable length. I can turn the pieces of aluminum angle around on the chuck to be able to handle up to around 4 inch diameter blanks.

If I make a second version, I would use a thicker main shaft because the 3/8" rod can flex a little bit. I would extend the bed at least another foot, so that I could do table legs. For tops and chess pieces, I have not found the need for a tool rest, however, I imagine it would be helpful when turning larger pieces, so version 2 would incorporate a tool rest.

step 19: Lathe Tools

I have used no commercial lathe tools, rather I made my own. The first picture is the cut off tool. It is basically a piece of steel mounted in a plastic handle that cuts straight into the wood for cutting the work off and making deep grooves. The second is a hook shaped tool I made for cutting the captive rings on the later projects.

step 20: Further Turning

Two more things I turned.

The first is a very small cup with a captive ring, meaning that the cup is one piece and the ring was cut from the middle of the stem of the cup. About 3" tall.

The second picture is a much longer thing (12") I made to test turning long items; it is basically a bar with 4 captive rings. Captive rings really freak people out when they realize the rings don't come off.