Making a Crankshaft for a Band (or Hand) Organ

David Wasson

Norman Gibson was building a small hand-cranked organ, and asked me to help him out in creating a crankshaft for his project. The need was actually for four crankshafts. Metal work can sometimes become a stumbling block for an organ project, and a suitable crankshaft is no exception. There are several ways to create a crankshaft. One way is to cut appropriate lengths of rod, for the shafts, and lengths of flat stock for the crank throws. The throws are drilled, and the whole assembly is welded together. To assure straightness, the center rod is left the full length of the crankshaft, and then the short sections at the throws, are cut away afterwards. The method I will describe, is almost like this, except that all parts are machined, pressed together, and then pinned. While welding will certainly do the job, machining all of the parts makes for a much neater job, and allows for the creation of the small shoulders on the throws that keep the pump sticks centered. As for straightness and concentricity, either method is probably adequate. A crankshaft on a band organ is not exactly what you would call a "high speed application," and high tolerance is not needed. You would certainly not want to use this method to create a crankshaft for a steam or gasoline engine.

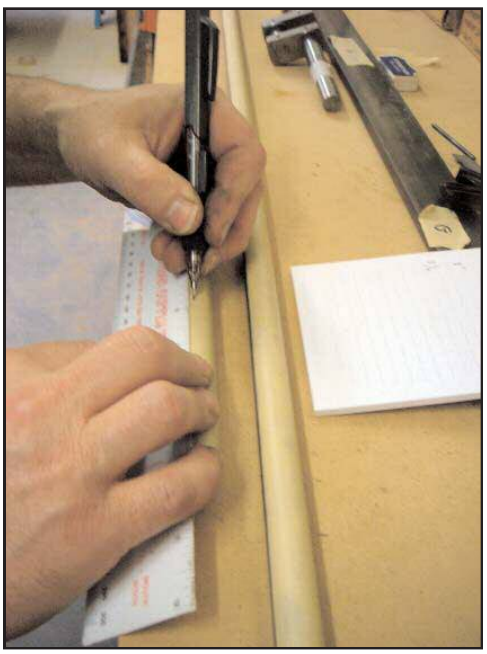


Figure 1. Marking stock for various shaft lengths.

The material chosen for this project is 1018 cold rolled steel. It is easily machined, and has a nice finish. **Figure 1** shows the round stock being marked for the various sections. **Figure 2** shows the round stock being cut on a band saw. If you use a band saw to cut the steel, make sure to hold the round stock in something that does not allow the stock to "spin" as it is being cut. On the right of the picture you can see a vice, upside down, for holding the stock. **Figure 3** shows the flat stock being cut. Make sure you leave a small space between the pieces for the width of the material that the blade will remove. You can see a small double set of lines marked on the stock showing the blade kerf.

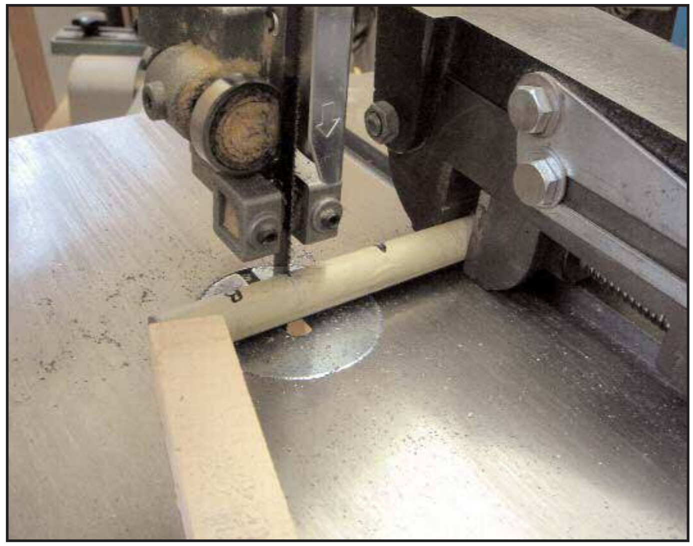


Figure 2. Cutting shaft stock with a band saw.

Figure 3. Stock marked to allow for removal of saw cut.

Figure 4 shows all of the throws cut, and ready to be marked and drilled. For marking most of the parts, a piece of masking tape placed on the steel works well for a surface to be drawn on with a pencil. For more accurate marking, a scratch awl is used. To more clearly show the mark left by a scratch awl, layout dye is painted on the steel. A wide tipped felt marker also works well to use as layout dye. The drilling of the throws is a three step

Figure 4. All flat stock cut for throws.

Figure 7. Reaming the drilled hole.

Figure 5. Center drilling.

process. The part is first center drilled as shown in **Figure 5**. The center drill is only used to make a small dimple in the steel, so the larger drill bit will have less tendency to "walk." The center to center distance of the holes in the throws is important to maintain.

Figure 6. Drilling the crank throw.

The second step, after the center drill is used, is to drill the hole in the throw. This is shown in **Figure 6**. You can see the "layout dye" left by the felt tip marker. The final size of the hole is ½", so a slightly smaller drill, 31/64", is used to allow for material to be removed in the next step. The last step is to ream the hole, shown in **Figure 7**. Use the slowest speed on the mill for this, and cutting oil as well. The hole is reamed to create a hole that is more uniform in size than what can be made with a drill bit. The table on the mill is moved the distance of the centers between the holes, and the process is repeated to create the other hole in the throw. **Figure 8** shows a single throw with both holes complete.

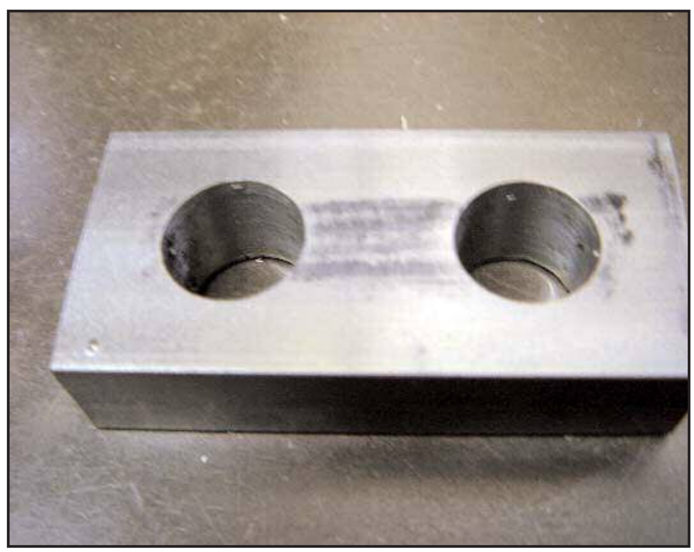


Figure 8. Holes completed on one throw.

Now, a mandrel is created that will allow for the last bits of machine work. **Figure 9** shows the beginning of the mandrel. Two of the jaws on the lathe are shimmed to insure concentricity. The mandrel is first faced, and then

Figure 9. Facing mandrel.

turned to a diameter that will allow the throw to just slip onto the mandrel. The end of the mandrel is single point threaded on the lathe, and a wide face nut is created to go onto this. The shoulder of the mandrel and the face of the nut need to be wide in order to have enough friction to hold the throw in place while being turned on the lathe. I did not go through the trouble of putting wrench flats on the nut, as you can tell by the marks left by the pipe wrench!

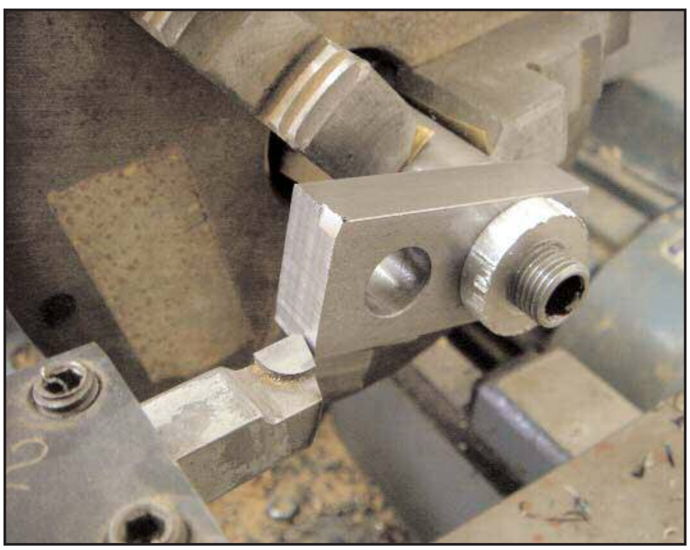


Figure 10. Machining the end of the throw.

For an interrupted cut, high speed steel will wear very quickly. I used carbide tipped tool bits for machining the faces and ends of the throws. Carbide does not really like interrupted cuts either, make sure you have an appropriate wheel to sharpen carbide! Each throw is placed on the mandrel, and the nut tightened. The end of each throw is machined first, as shown in **Figure 10**. **Figure 11** shows the machining complete on the end of one throw. The face

Figure 11 (above). The completed throw end.

Figure 12 (below). The facing throw.

Figure 13. A completed throw face with shoulder.

of the throw is machined next. The start of this operation is shown in **Figure 12**. The facing continues until a shoulder is formed on the face of the throw, **Figure 13**. The diameter of the shoulder is not critical. I used the diameter of the nut as a place to indicate the finished diameter. The shoulder is only machined on the inside face of each throw. The outside can be done as well, but is not necessary. A finished throw is shown in **Figure 14**.

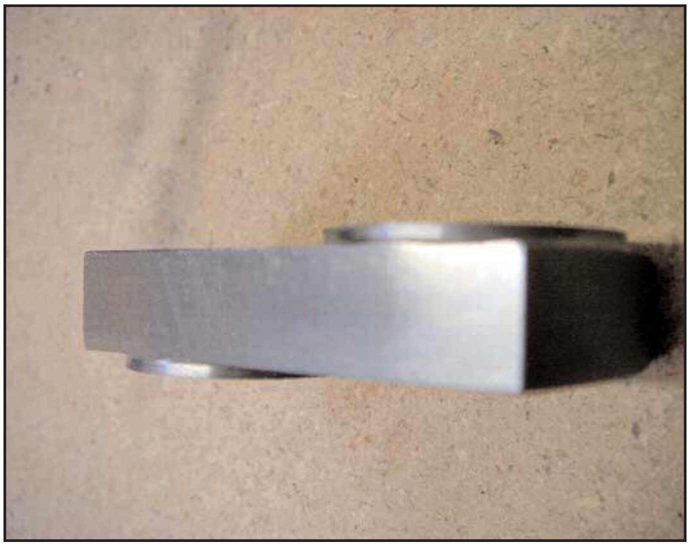
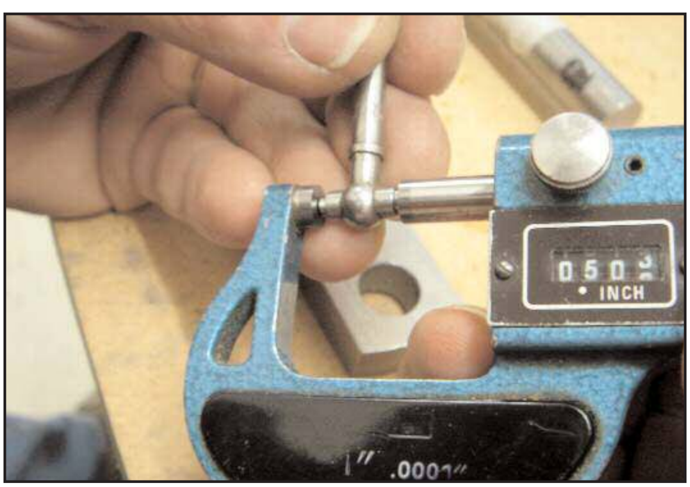


Figure 14. The completed crankshaft throw.

Figure 15 (above). Measuring inside diameter of throw.

Figure 16 (below). The measuring gauge.



Now, the shaft ends are machined to fit each of the holes in the throws. In order to have a good tight fit, the shaft ends are machined for an interference fit of about .001". The inside diameter of each hole should be measured in several places, **Figures 15 and 16**. If you measure carefully, you will discover that the holes are not exactly the same dimension everywhere. This is important to know if you are creating a shaft diameter that is .001" larger than the hole. If the holes are reamed for ½", they are probably slightly oversize one or two thousandths. If the hole is .501", then the shaft should be machined to .502", **Figure 17**.

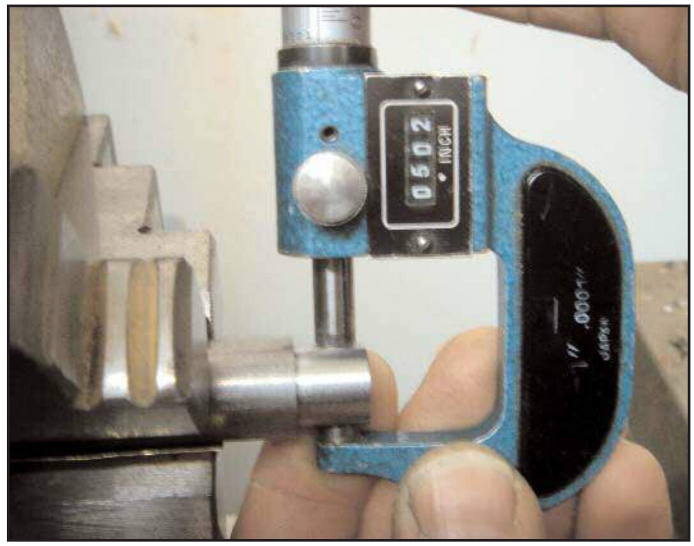


Figure 17. Measuring the shaft end.

The throws and the shafts can be pressed together with an arbor press, or even a large rawhide mallet. The first two sections pressed together, must be at exactly 90 degrees to each other. The crankshaft is assembled from the inside, to the outside. The center section is pressed together first, **Figure 18**.

Figure 18. First two throws pressed onto the center shaft piece.

With strategic assembly, you want to avoid ever pressing on the outside of a set of throws, this will bend the crankshaft for sure. Each set of throws must be parallel to each other. This can be assisted by putting the pairs of throws in a vice as they are pressed together.

Figure 19. Center drilling for the tension pin.

After all of the sections are pressed together, they are pinned as well. **Figure 19** shows the center drill being used first, and **Figure 20** shows the hole being drilled for the pin. The pin used, is a tension pin, or "roll" pin. It is being installed in **Figure 21**. Make sure the hole drilled for the pin is enough under size to create a proper fit.

Metal work can sometimes become a stumbling block for an organ project, and a suitable crankshaft is no exception.

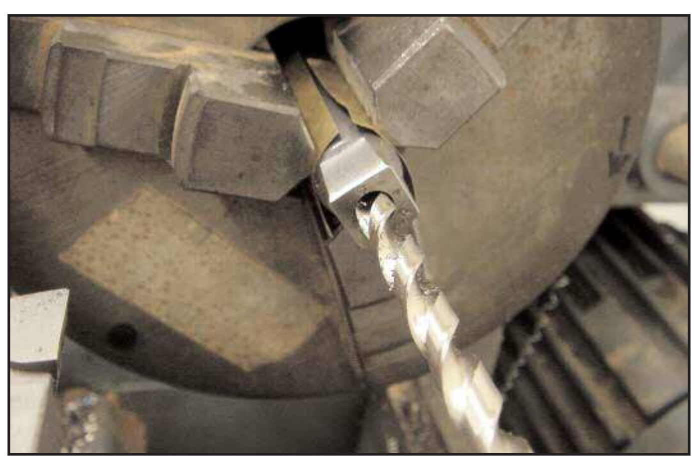
Figure 20. Drilling for a tension pin.

Figure 21. Installing the tension pin.

The handle that Norman Gibson wanted to use, had a slightly tapered square hole. To accommodate this, the end of the crankshaft had to be machined to fit. **Figure 22** shows the tapered square being machined of the end of the shaft. The shaft also had to be drilled and tapped to hold the handle to the shaft, this is shown in **Figures 23 and 24**.

Figure 22 (above). Machining tapered square on the shaft end.

Figure 23 (below). Drilling the shaft end.



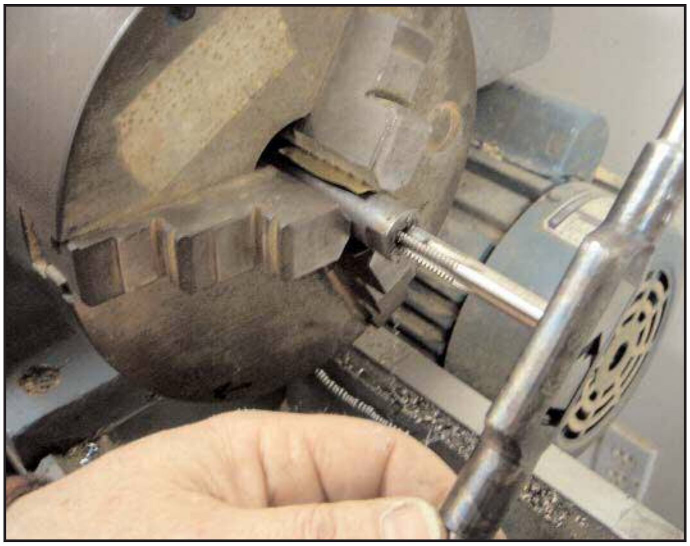


Figure 24. Tapping the shaft end.

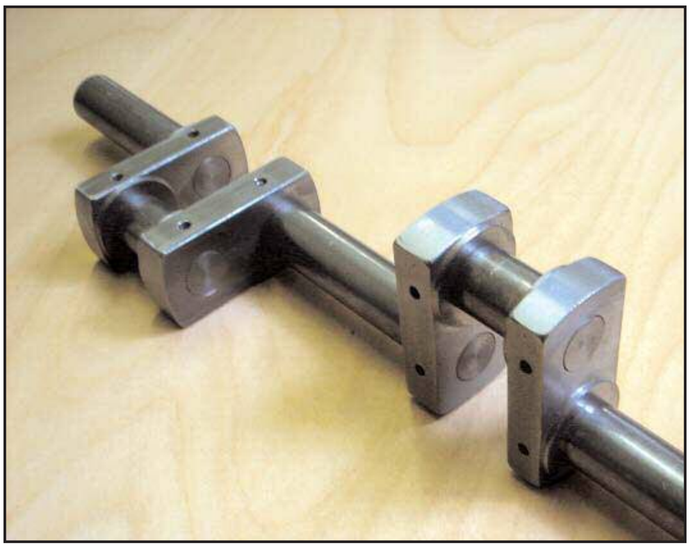


Figure 25. The completed crankshaft.

With all of the machine work done, one of the finished crankshafts is shown in **Figure 25**. **Figure 26** shows a finished crankshaft installed in an organ.

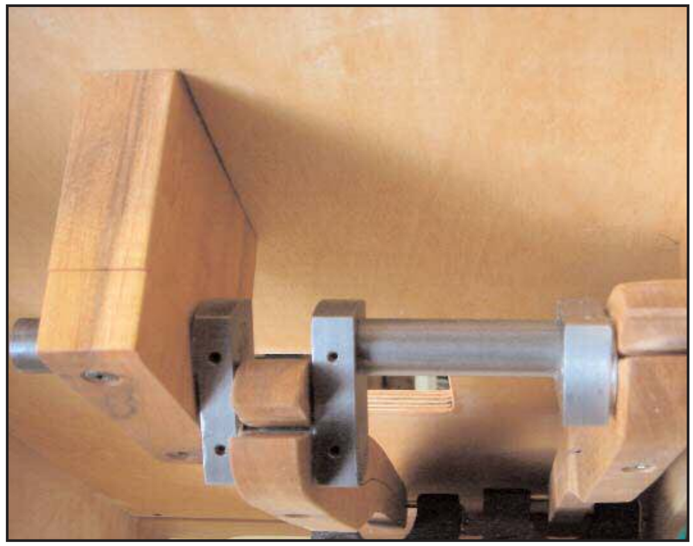


Figure 26. The crankshaft installed in an organ.

All photographs by Norman Gibson.

David Wasson has been building and experimenting with pneumatic devices for automatic musical instruments for over thirty years. Much of his inspiration for band organ construction has come from fellow organ builders, especially Ken Smith of Ohio.

In memory of . . .

Jerry Doring of Arcadia, California was age 91 when he passed away on October 3, 2009 after a 10 month illness. Jerry was married to Virginia for 63 years and they had four children. He became interested in mechanical instruments in 1958 when he was recovering from a long illness.

He was a 1st Lieutenant in the Army during WWII and served in the Philippines. He worked with his sister in a family-owned music store. Later he earned his living selling insurance (Jerry Doring Insurance Agency). The business was sold in the 1980s and his time was devoted to building and maintaining his collection of mechanical music. Jerry's daughter, Wendy, recently noted that as her father failed physically his greatest pain was not being able to engage in his hobby.

Contemporary members will remember Jerry was a COAA author who recently wrote an article on his Bruder Elite Apollo Carousel Organ (issue #40) with the beautiful centerfold photo.

I first met Jerry in 1976 at a mechanical music convention. At that time he had quite a collection of musical instruments including a roll-operated 52-key Gebr. Bruder. As time progressed, and I acquired my own Bruder (book-operated), I enjoyed obtaining and copying some of Jerry's arrangements for my own organ.

We will miss Jerry but will remember him for his passion in collecting as well as his wonderful contribution to the COAA's journal, the ***Carousel Organ.***

Ron Bopp