Shay Truck Machining II - Wheels

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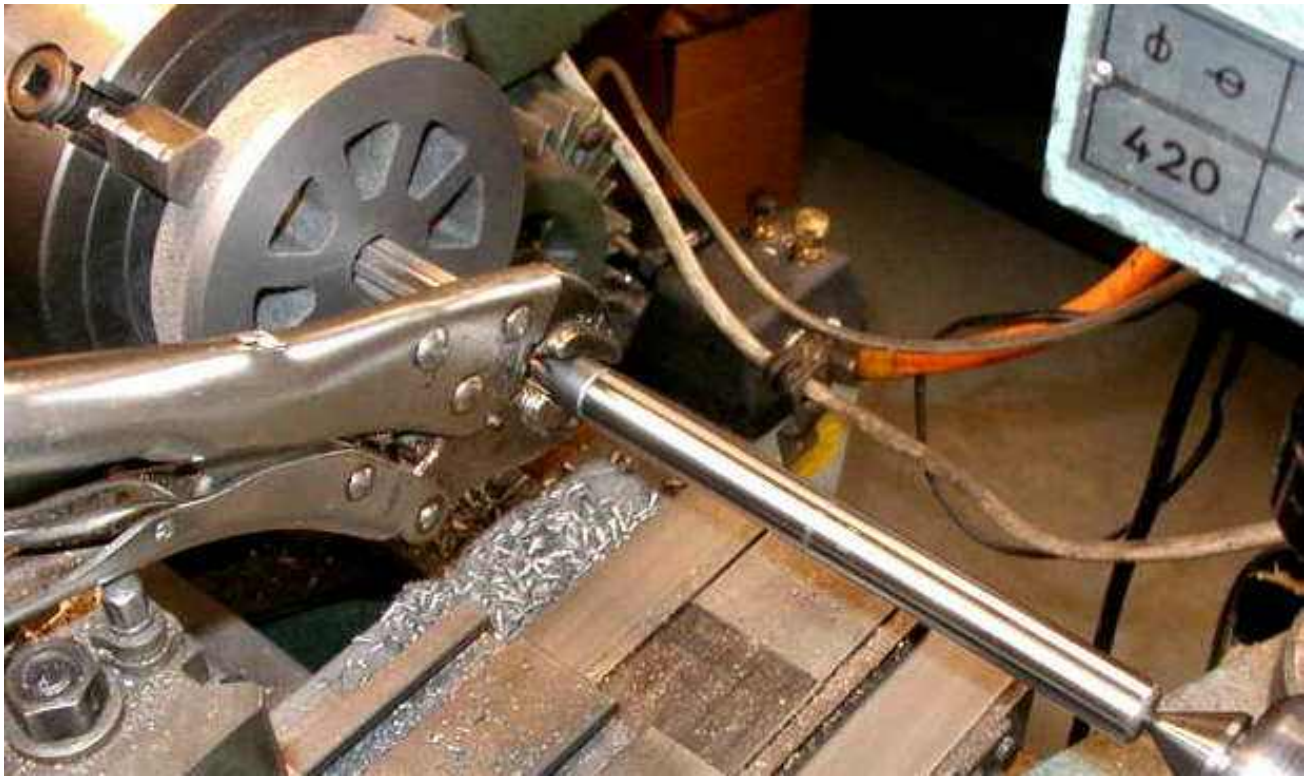
After machining the Journal Boxes and Pedestals I then tackled the wheels. I discovered that the wheels were too large for my 3-jaw chuck but fitted nicely in the 4-jaw chuck when the jaws were reversed. The left photo below shows centering a wheel casting in the chuck. The next step was to face the wheel as shown in the center photo below followed by turning the correct flange diameter as shown on the right below.



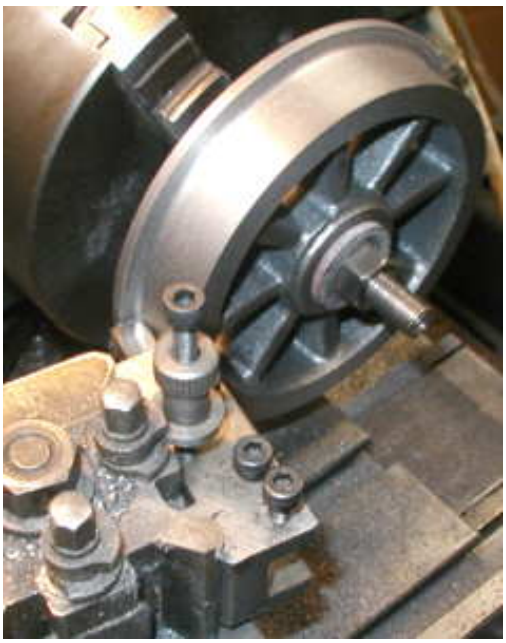
The next operation was to make the hole for the axel. This operation required center drilling (left photo below), drilling an undersized hole (center photo) and then boring the hole to about 0.010" undersize. The boring operation created an exactly round and centered hole.



The final step was to ream the hole to the exact required size as shown below. The reamer shaft size was larger than any of my tailstock chucks so I used a center to keep it aligned and vise grips to keep the reamer from rotating. I then advance the tailstock to ream the hole. I sure hate to use vise grips on anything, but it was the easiest solution for me.

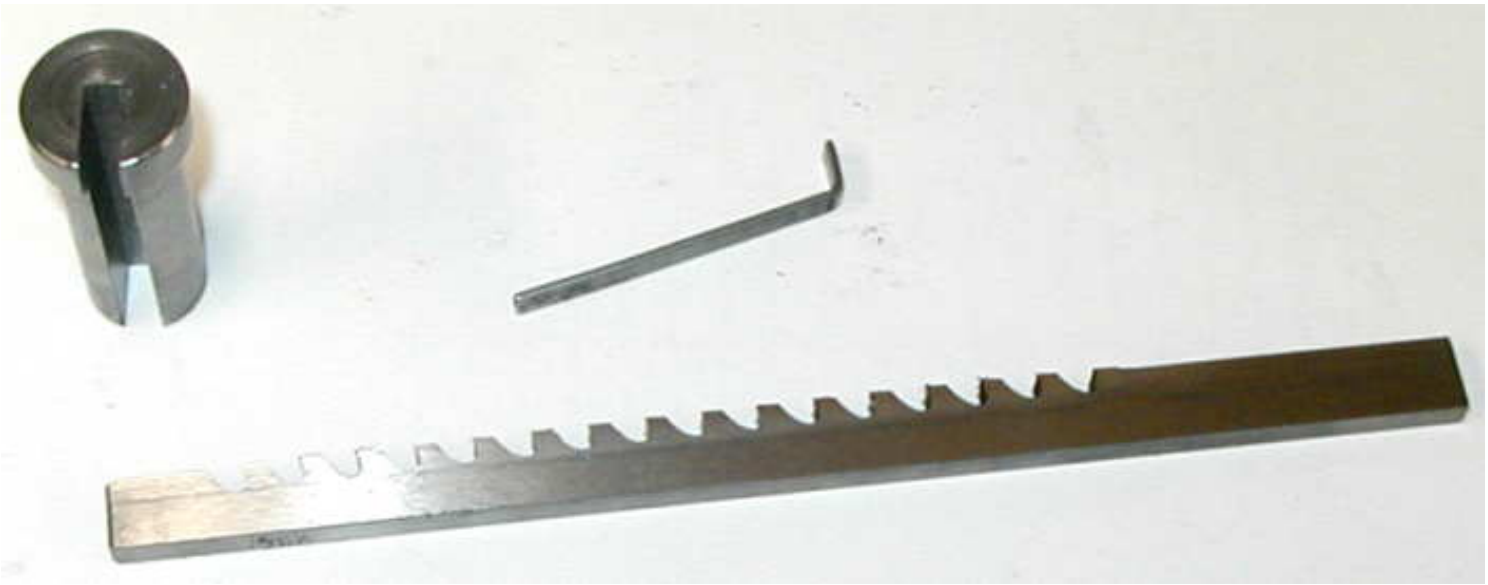


The next step was to reverse the wheel in the chuck and face the front and turn to the correct width. This was was done on all wheels before proceeding further. Next, a stub axel was turned and each wheel mounted on the axel and the wheel turned to the correct diameter and taper as shown in middle photo below. This was done on all wheels. Each wheel was mounted on the stub axel again and the flange was turned to the correct thickness and taper as shown in the right photo below. Next, a file was used to round the edges.



The Gears: Recall that a bevel gear is attached to each right wheel. Standard off-the-shelf gears are used but modified as shown below. First a recess is bored in each gear. The photo on the left below shows an unmodified gear beside a gear with the recess. The square boss on the RH Journal Box fits in this recess. The next step was to cut down the length of the shoulder on the gear. The right photo below shows gears with and with out the reduced shoulder length. The gears are made of a very fine quality steel that machines easily and gives a very smooth surface. Obviously, these are unhardened versions of the gears.

Cutting Keyways: Keys are used between the wheels and gears and the axels to insure they all turn together. A broach is used to cut the keyway in the wheels and gears. I'd never used a broach before so the operation was novel. The broach is shown in the photo below. The notched bar is the actual broach. The cylinder is a sleeve with the same diameter as the hole in the wheel and gear. The little bent piece is a shim.



The broaching operation is shown in the left photo below. In this case I'm cutting the keyway in a wheel and gear together. (The thickness of the hole in the gear is small making it difficult to keep the broach perpendicular to the gear face. This is not a problem with the much thicker wheel and doing a wheel and gear at the same time worked well.) The sleeve is placed in the hole and the broach then pressed though the slot in the sleeve. Each succeeding tooth on the broach is slightly longer and takes a small cut in the gear and wheel. One pass of the broach cuts a slot exactly half the required depth. The little shim is then inserted in the slot in the sleeve and the broach pressed through again to double the slot depth. The finished slots in the gear and wheel are show on the right. Sure beats trying to file a slot!

The gear is attached to the wheel with four flathead screws. The easiest way I could figure to drill the holes was to make a template as shown in the left photo below. A keyway was cut in the stub axel used to turn the wheels and it was placed in a drill press vise. A gear and the template was then slid on the axel and the four holes started in the gear. The gear was removed and the holes drilled through. The wheel and the gear were then mounted on the stub axel together and the gear used as a template for the holes in the wheel as shown o the right.. The wheel holes were tapped, the holes in the gear were enlarged to the clearance size and counter sunk.

This is a finished set of wheels for one axel.

Axels: The axels are machined from 3/4" cold rolled steel rod. The ends are turned to 5/8" for the wheels and then stepped down to 3/8" for the bearing and the end threaded for the retaining nut.

A slot must be cut in the axel for the key. In this case it is a simple operation to cut the slot with an end mill as shown on the right.

The final wheel/axel operation was to press the wheels on the axel. I used my hydraulic press as shown on the right. The wheels were a pretty tight fit and considerable force was required to get the wheels on the axel. I spread a small amount of Loctite near the inside shoulder of the axel as insurance that the wheel and key will stay in place.

This is an assembled set of wheels and axels for one of the three trucks. The bronze disk is the eccentric used to drive a water pump. The eccentric is used only on the rear axel of the middle truck.

On to the flat bars, see next note .....

Update: Some months after machining the wheels I visited the shops at Cass WV. The photo shows the lathe they use to surface wheels. It won't quite fit in my workshop.

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