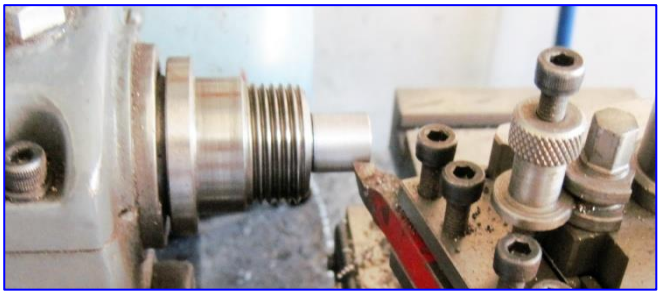
Machining locomotive wheels

This document was written by Mike Wheelwright and was originally published by Worthing and District SME in their newsletter in the Winter of 2015.

I have just turned the coupled wheels for my Scot and realised that over the years I have done 41 of them in 3½"and 5"G (an average of one a year), plus the innumerable small wheels. I find this job to be quite enjoyable (compared with, say, platework) and with a bit of experience it is very easy as long as it is done in an organised way and the castings are of good quality. Of course, the wheels go round, but that's all, no "bobbing up and down like this" or "rolling in the aisles"; i.e. they need the seating hole located absolutely concentric with the tread and at right angles to the plane of the wheel. I found this out the hard way before I had a 3½" lathe, I tried turning my first 4" dia. drivers in the gap of a miniature lathe and used a drill for the seating holes. Once I had the right equipment, I corrected them following the method described by Don Young, all I had to do was make the simple turning fixture shown in the photo.

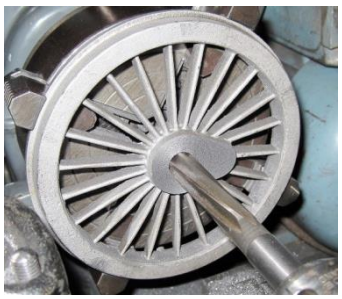
There are various ways of turning wheels but as mine (or Don's) has worked so well it may be of interest to others. The secret is in the order of machining: first face the rear as a locating reference, then on a backplate, front-out, ream the axle seating hole. After this each of the various machining operations can be carried out on one wheel after another before moving on to the next operation, this avoids repeating tool set-ups and is quite easy to do as castings can be slipped on to the arbour, pushed against the faceplate and held by tightening the nut, the casting is driven by a peg or screw in the faceplate. This guarantees repeatable location so everything comes out concentric and square.

The fixture was run up in 1977 as one of my quick-fixes and is still in use. As can be seen it is an arbour with a 2MT taper and drawbar to hold it in the lathe, the taper is just too short to project beyond a fitted faceplate, then the steel stub sticks out just less than the thickness of a finished wheel (9/16" in 5"G) and the end is threaded something like ¼ BSF. The stub on mine is 7/16" dia. as this is the smallest axle seat I have ever needed but before each turning session an arbour needs to be machined to the appropriate diameter for the wheels in hand, this is easily done by slipping on a sleeve retained by Loctite and turning it down (Photo 2). If the fixture is not released until the wheels are finished there is no way in which this arbour can be anything other than concentric and at right angles to the faceplate, I thrive on things like this, nothing to go wrong! When the fixture is to be used for another size of wheel seat the arbour is turned down or a new sleeve fitted.



The first operation, facing the rear of the wheel, is the most difficult depending on the size of the casting relative to available chucks, faceplates, etc. and also on the quality of the casting in the sense of roundness and flatness. Sometimes it can be held in a 4-jaw chuck by the tread so as to run approximately concentric with the back held vertical; with my current job I was fortunate as the finished diameter was only 5" and concentricity and flatness were good. The wheels had been cast with a solid backing to the spokes (Photo 3) so there was no "mismatch" between front and back halves on a mould parting line; this is the first time I have come across this way of casting wheels and of course there is a lot of material to be removed from the back. However, the concentricity and lack of blow holes in the spokes makes it worthwhile. In the past I have dealt with large uneven 5"G castings by setting them up on a big backplate with bolts through the spoke spaces and varied packing pieces under the rim to get the rear something like vertical for the first facing cut.

The second operation is to set the casting front-out in a 4-jaw chuck or on a backplate ready for reaming the seat (Photo 4). Concentricity is important, but not with the cast tread, the wheel should be adjusted until it rotates with the inside diameter of the rim concentric, i.e. the edge of the surface at the outside of the spokes. If this is not done, although the treads will be concentric and the wheels will run satisfactorily, they will appear to "bob up and down" as the centres are out. The ability to set the rim concentric depends entirely on the circularity of the casting, some suppliers are excellent but unfortunately others are far from it. You can only do your best.



Once satisfied then the hole can be reamed: do be careful about drill wander, it is best to use a small boring tool to get things in line just under the specified diameter so the reamer is left to get the finished size. From this stage on it is easy, just a question of going through each operation in turn after fitting a faceplate and putting the castings on and off the fixture (Photo 5): face rims and bosses, turn treads to slightly oversize, turn flanges almost to the tread, finish tread diameter using small round nose tool for root radius at the flange (if the tool setting is locked all wheels must be of the same diameter!). The decorative bits like chamfering the edge of the tread and rebating back the inside of the rim to simulate the tyre are soon done.

I haven't mentioned balance weights: of course, they are irrelevant in our scales but they are needed to look right. Various types can be seen according to the prototype: cast-in to spoke thickness, or to tyre thickness, steel plates, etc, so each model needs a different approach. I tend to build "own-designs" but I try to use existing castings to avoid pattern making so this usually means fitting my own balance weights, luckily some castings come without weights so they can be added in any position using body filler for the cast-in type and plates for the others. Do be careful to check the length (over how many spokes), size and position from photographs, easier said than done as all posed photos have cranks down with some, or all, balance weights out of sight. Normally driving wheels differ from other coupled wheels, especially with inside motion where the weights will be in quite a different position relative to the crank pin.

The final job is to ream the holes for the cranks, again they must be perpendicular to the wheel face and while a small difference in radius from the wheel centre is not important, they must all be the same if the coupling rods are to rotate without binding. There is one simple solution, yes, another jig, but this time it is merely a piece of plate with a stub to fit the wheel centre and a crankpin sized hole at the required radius; when drilled and reamed on a drilling machine everything will be OK. That about covers coupled wheels that go round …. now back to machining carrying wheel No 55!