

Another little job No 4: Locomotive wheel quartering

First of all, what is wheel quartering all about? In order for a steam locomotive to move off from rest it needs one of the pistons to be in a position to apply force to turn a driving wheel. On a two cylinder locomotive if the crank pins of the wheels on one side are in a fully forward or fully backward position their piston cannot do this (the piston is right at the front or back end of the cylinder) so the wheels on the other side of the locomotive are set at 90 degrees to them. The crank pins on that side are then either fully up or fully down and their piston, being half way down the cylinder, can apply full force via its connecting rod to turn the wheel. The wheels on opposite ends of the same axle, being set at 90 degrees to each other, are said to be 'quartered'. The quartering angle does not actually have to be exactly 90 degrees (a degree or two off will make no real difference) but on locomotives with more than one pair of driving wheels joined by coupling rods (i.e. all but things like Stirling Singles) the angle needs to be exactly the same on all axles, otherwise the coupling rods will bind on the crank pins as the wheels turn (note that the crank pins all need to be exactly the same distance from the centre of the axle as well). Some kind of jig is normally used to ensure the same quartering angle is set when the wheels are put onto the axles.

There are lots of different designs of jig around and if you Google "wheel quartering jig" you will find lots of information and advice on how to do it. Some of the jigs look simple and others rather complicated. In the days before industrial adhesives (such as Loctite - other brands are available!) wheels were a press fit on the axles and the jig had to accommodate this. That is still the case in full size but in model sizes we have the luxury of much easier fits and adhesives such as Loctite Retainer which can simplify the jig required. No doubt all the jig designs around have their pros and cons, the main thing being that you need to be able to assemble the wheel & axle set and get it in the jig before the adhesive cures!

When I needed to quarter the wheels of my 2-6-0 locomotive I used a simple jig which clamped the wheels between two flat steel plates, locating the axles and both crank pins precisely - I hope the photos make it clear how it is made and works. The two side plates are held 115mm apart by three ½ inch diameter steel stretchers which have a male M6 thread on each end. One end of each stretcher is permanently secured to a side plate with a nut, the other plate is secured to the stretchers with wing nuts. The 115mm gap is not critical but you do need to make sure it's not too big so that the axles are held accurately and the crank pins poke through their setting holes. Obviously the wheels and axles have to fit in the gap without fouling on the side plates.

I made two little 2BA threaded axle supports, each with a 60 degree cone machined on one end to locate in the centre drill holes in the axle ends. They have lock nuts on the outside so that they are adjustable and don't wobble around. The crank pin holes are drilled as accurately as you can, preferably using the same drilling jig as should have been used to drill the crank pin holes in the wheels. When you make the side plates mark out all the holes on one of them then clamp them together. Drill one stretcher hole and put a bolt in that hole, then drill the other two stretcher holes and put bolts in them. Now drill the holes for the axle supports (2BA tapping size in my case) and the crank pin holes. I initially drilled the crank pin holes under size and, having separated the plates opened out two of them, at 90 degrees to each other, to accept my loco's crank pin diameter. That way, when I hurriedly put the axle and wheels in the jig with the Loctite on I cannot get the crank pins in the wrong holes because they will not fit!

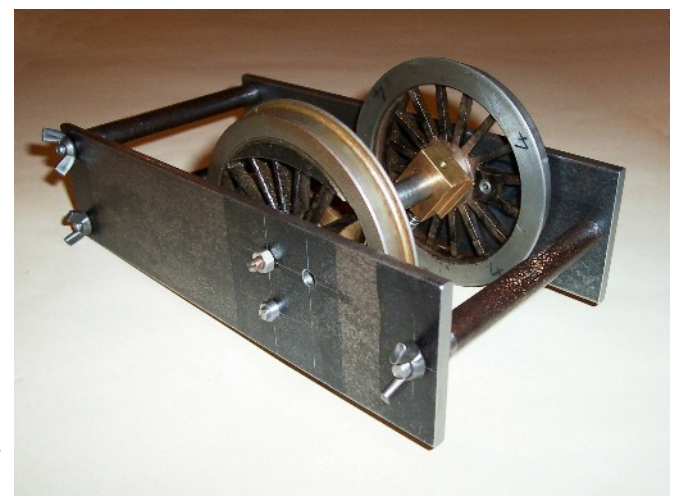
The crank pins on my locomotive are of different designs on the three pairs of wheels so the holes for the crank pins in the jig side plates are a close fit for the longest and largest diameter crank pins. I made little steel



This is my wheel quartering jig complete with scribe marks from marking out! The 2BA nut you can see locks the axle support cone in position.



This wheel has a sleeve on the crank pin to fit the larger holes in the jig side plates.



A wheel set clamped in the jig whilst the Loctite cures. The axle is tightly held between two 2BA coned pins (one seen with a locknut here). The crank pin is protruding through the hole below it and the side plate is held on by M6 wing nuts.

sleeves (brass would do) to fit over the other crank pins so they fit nicely in the side plate holes and the centre lines are always correct. For storage I screw all the sleeves to one of the side plates so I don't lose them.

With some types of jig the crank pins are pushed against two metal edges rather than inserted into holes. They have the advantage that you don't need accurately drilled crank pin holes in the jig. They may or may not be easier than mine to assemble quickly but you do have to make sure the crank pins stay pressed against their setting edges until the Loctite cures. Photos on the internet will probably clarify what I mean.

I like my jig because it is very positive - i.e. if the axle is held correctly between its conical supports and the cranks pins are in their holes then it must be right. The only thing to watch is how quickly your Loctite adhesive cures - it starts soon after you push the wheel onto the axle. Typically you only have around 20 seconds or so to get the wheel set in the the jig before the adhesive grabs. If it all goes wrong don't worry - if you heat them up to more than 150°C either in the domestic oven (do it when everyone else is out!) or with a hot air gun or blow torch you can pull the wheels off the axles and start again. Before you apply the Loctite I recommend you put the axle between the plates and lock the conical supports in position with locknuts. Then when you put the second wheel on all you have to do is line up the crank pins with the correct holes and whack the side plate on quick with the axle between the pre-set cones. You will need to re-set the axle support cones for each axle because they will all be slightly different. It will also be worth doing a few dry runs before putting the Loctite on to get the hang of assembling the wheel/axle set in the jig and learn what the trickiest bit is.



The little cone seen here supports the axle by locating in a centre drill hole in the axle end. The larger of the two holes locates the crank pin, the smaller one is redundant.



The crank pin sleeves are screwed to one of the side plates for storage so I don't lose them!