Quartering locomotive driving wheels

1. NOTES
In the prototype locomotive the driving wheel crankpins are set so that one side leads the other by a certain number of degrees. Generally, the crankpins on the right hand side wheels (looking along the chassis from the back towards the front) lead the left hand crankpins by 90°.

There are exceptions to this. Locomotives with 3 cylinders will, generally, have the cranks at 120° others will have the left hand side leading.

The term ‘quartering’ is given to the process of ensuring that the crankpins of each pair of wheels (on the axle) are in exactly the same relationship to each other as all other pairs of wheels in the same chassis.

In order to obtain a smoothly running locomotive chassis it is essential that among other things, the wheels should be accurately ‘quartered’ (these other considerations are beyond the scope of this Manual sheet).

These notes will:

- attempt to describe the quartering’ procedure where the right hand crank leads the left hand crank by 90° - the principles and techniques apply to all the others equally.

and will assume:

- that the chassis is square in all planes and that except for the ‘quartering’, is smooth and free running, and that the axle bearings have been reamed out to the appropriate diameter.
- that the wheels are of the Ultrascale, Sharman or Gibson type and are concentric, although the basic principle applies to all types.
- that the coupling and connecting rods are from etched nickel silver kits, are jointed (as per prototype) and have been constructed according to the manufacturers instructions.

2. MATERIALS REQUIRED.
In addition to the completed chassis:

- Two driving wheels (of the appropriate size for your locomotive) and one axle for each axle position on the chassis.
- Crankpins, and associated nuts washers for each driving wheel.
- Set of coupling rods to suit locomotive.
- Set of connecting rods to suit locomotive.
- Motor and gears of your choice.
- Solvent - such as Isopropyl alcohol (for degreasing axle ends and wheel hubs).
- Loctite 601 (NB: Loctite 601 has subsequently replaced Loctite 601).

3. TOOLS REQUIRED.
- Small pin vice.
- Spanner and screwdriver to suit crankpin nuts and screws.
- Wheel back to back gauge (or method of measuring appropriate dimension if using the Mike Sharman method of distancing this range of wheels).
- Set of taper broaches.
- 2 - 3mm diameter drill.
- Piece of 1/4 plate glass (as a plane surface).

4. PREPARATION.
Remove any ‘flash’ from wheels.

‘Blacken’ wheel rims.

Ensure axles are of correct length and deburr axle ends. File a ‘flat’ in centre of one axle to provide positive location for the gear wheel grub screw, the exact position of the flat will depend on ultimate position of gear wheel grub screw (this is the driven axle).

Using drill, in fingers, gently very slightly countersink both sides of all bearing holes in coupling and connecting rods and crankpin bearings.

Using taper broach(s) very gently ‘ream’ coupling and connecting rod bearing holes to give a close running fit on the crankpin bearings. Do NOT use a Rat Tail file for this, it will leave the bearing surfaces rough and susceptible to wear and jamming up.

‘Blacken’ coupling and connecting rods.

Fit crankpins to each wheel (if crankpins are based on a screw tightened from the back of the wheel, a tiny amount of Loctite 603 is useful on the thread where it passes through the wheel to prevent the screw working loose). (Refer to EMGS Manual sheets 2.5.2.(1) and 2.5.2.(2) for crankpin fitting methods).

Ensure that crankpins are parallel to axle, fit crankpin bearings, tighten nuts only sufficient to prevent bearings falling off.

5. METHOD - FIRST WHEEL.
Take one wheel and one axle - clean wheel hub and axle end with solvent.

Place axle into wheel hub, from rear, until about a quarter of the way through.

Place tiny amount of Loctite 603 around inside of wheel hub, and around axle end adjacent to wheel back.

Press axle fully home until axle end is flush with wheel hub front face.

Repeat 5.1 to 5.4 for each axle. (one wheel should now be mounted on each axle).
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6. METHOD - DRIVEN (REAR) AXLE.
Put driven axle through chassis, not forgetting to fit any bearings, washers or gears /motor required. (Do not tighten gear onto axle at this stage).
Take second wheel, clean its hub and axle end with solvent.
Place axle into wheel hub, from rear, until about a quarter of the way through.
Ensure right hand crank leads left by about 90° (looking at chassis with right hand side facing you put the LEFT hand crankpin in the top centre 12 o'clock, position, and the RIGHT hand crankpin in the right centre, 3 o'clock, position). Make a note of the way the opposing spokes line up (sight through wheels across top, or bottom, of frames and, if possible, line up opposing spokes). It does not matter if the crankpin angle is slightly more or less than 90°, the important thing is that the crankpin angle is identical on the wheels on each axle.
Apply tiny amount of Loctite 603 around inside of wheel hub, and around axle end adjacent to wheel back.
Press wheel onto axle to correct spacing and clean off surplus Loctite.

7. METHOD - SECOND (MIDDLE) AXLE.
Repeat 6.1 to 6.4 for second axle (on an outside cylinder 4-6-0 this is normally the wheel side to which the connecting rods are attached. Make sure the correct crankpin bearings are on this wheelset).
Place appropriate coupling rod sections over the crankpin bearings, tighten crankpin bearing retaining nuts to finger tight. The chassis is effectively now an 0-4-0.
Place chassis, wheels down, onto the piece of glass, check that both coupling rods are parallel to the glass.
Run chassis gently back and forth by hand. If it will not run smoothly it is probably caused by the wheels being slightly out of 'quarter', indicated by a 'tight' spot in the same position during each revolution.
Hold the LEFT hand wheel of the second set tightly in one hand. With the other hand grip the RIGHT hand wheel and gently twist clockwise. Try running chassis back and forth on the glass. If running is easier, but still has a 'tight' spot, again twist gently clockwise. If the 'tight' spot appears harder, twist gently anti-clockwise, repeat until satisfied you have eliminated all tightness.
Remove the coupling rods.
Put a tiny amount of Loctite 603 on wheel hub and axle end adjacent to wheel back.
Press wheel onto axle to correct spacing.

8. METHOD - THIRD (FRONT) AXLE.
Repeat 6.1 to 6.4 for third axle.
Place appropriate coupling rod sections over the second and third wheel crankpin bearings, tighten crankpin bearing retaining nuts to finger tight. The chassis is now, effectively a 2-4-0 (or 0-4-2).
Place chassis, wheels down, onto the piece of glass, check that both coupling rods are parallel to the glass.
Run chassis gently back and forth by hand. If it will not run smoothly it is probably caused by the wheels being slightly out of 'quarter', indicated by a 'tight' spot in the same position during each revolution.
Hold the LEFT hand wheel of the third set tightly in one hand. With the other hand grip the RIGHT hand wheel and gently twist clockwise. Try running chassis back and forth on the glass. If running is easier, but still has a 'tight' spot, again twist gently clockwise. If the 'tight' spot appears harder, twist gently anti-clockwise, repeat until satisfied you have eliminated all tightness.
Remove the coupling rods.
Put a tiny amount of Loctite 603 on wheel hub and axle end adjacent to wheel back.
Press wheel onto axle to correct spacing.

9. ADDITIONAL AXLES.
Follow the procedure in 8.1 to 8.8 for each additional axle in turn, setting each additional wheel set against its predecessor as an 0-4-0.

10. OTHER WORK.
Fit coupling rods to one side of chassis, finger tighten all nuts, check run chassis, if satisfied, fit the other side coupling rods, check run chassis again. Any overall tightness can be removed by VERY GENTLE use of taper broaches on coupling rod bearing holes.
IT IS VITAL NOT TO OPEN OUT THE BEARING HOLES ANY MORE THAN IS ABSOLUTELY NECESSARY, excess clearance can in itself cause chassis to run poorly.
Tighten up gear grub screw and apply about 1/4 power to motor, so that motor just keeps the wheels turning steadily. Satisfied?
Remove crankpin nuts. Degrease nut and screw threads, replace, fully tighten all nuts.
Apply drop of Loctite 603 to end of each thread and wipe off any excess with tissue.
As a final refinement the bearing surfaces can be polished by applying a small amount of Brasso to each bearing, and the gear/worm (provided both are metal), together with some WD40. Allow chassis to run at 3/8 power for about 1 hour, alternating 5 minutes forward / 5 minutes reverse, with chassis supported in a vice or across two blocks of wood.
Finally flood bearings with WD40 and run chassis at full power, alternating forward and reverse, to clear Brasso from bearings. (The WD40/Brasso mix will be thrown everywhere).
11. SOLID COUPLING RODS.

Solid coupling rods pose an additional set of problems as it is not possible to treat the chassis as separate 0-4-0 units.

Follow notes and procedures from section 1 to section 7.8 inclusive. This will give a ‘quartered’ 0-4-0 based on the rear and middle axles.

Remove coupling rods to allow fitting of next wheelset to chassis. Put third axle through chassis, not forgetting to fit any bearings, washers, etc., required.

Take second wheel, clean its hub and axle end with solvent.

Place axle into wheel hub, from rear, until about a quarter of the way through.

Ensure right hand crank leads left by about 90°. (looking at the chassis with the right hand side facing you put the LEFT hand crankpin in the top centre, 12 o’clock, position, and the RIGHT hand crankpin in the right centre, 3 o’clock, position). Make a note of the way the opposing spokes line up. It does not matter if the crankpin angle is slightly more or less than 90°, the important thing is that the crankpin angle is identical on the wheels on each axle.

Place one coupling rod over the crankpins of all three wheels on one side and tighten crankpin bearing nuts finger tight.

Repeat 11.7 for other side wheels and coupling rod.

Place chassis, wheels down, onto the piece of glass, check that both coupling rods are parallel to the glass.

Run chassis gently back and forth by hand. If it will not run smoothly it is probably caused by the wheels being slightly out of ‘quarter’, indicated by a ‘tight’ spot in the same position during each revolution.

Hold the LEFT hand wheel of the third (front) set tightly in one hand. With the other hand grip the RIGHT hand wheel and gently twist clockwise. Try running chassis back and forth on the glass. If running is easier, but still has the ‘tight’ spot, again twist gently clockwise. If the spot appears harder, then twist gently anti-clockwise. Repeat until satisfied you have eliminated all tightness.

Remove coupling rods.

Put tiny amount of Loctite 603 on wheel hub and axle end adjacent to wheel back.

Press wheel onto axle to correct spacing.

Repeat 10.1 to 10.4