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Setting and Fixing Eccentrics

This document was written by Mike Wheelwright and was originally published by Worthing and District SME in their newsletter in the Spring of 2011.

Mike introduces us to the ingenious yet simple methods he applies to setting and fixing pairs of eccentrics at the correct angle.

Until recently I hadn't thought much about eccentrics, not surprising really as I gave up water pumps years ago and all my previous engines have radial valve gears, either outside Walschaerts or Joy. The year 2010 presented me with the opportunity to catch up with these wobbly things in no uncertain way as the Whitworth has the usual complement of two pairs of eccentrics for the Allen Straight Link Motion while the Compound sports 3 pairs for the Stephenson motions, so I was able to cut my teeth on the manufacture and fitting of 10 eccentrics! For Walschaerts gear I had sussed out a really accurate and foolproof way of manufacturing and fitting the return crank so that this critical item really was a doddle and always right first time, so what I needed was an equivalent procedure for the pesky wobblers. You have probably heard my views about the idea of setting valve gears by adjusting things on an assembled engine, I find it very difficult to do at all, let alone to do it well and as for successfully fixing everything tight once set I won't even think about it. How often do we hear moans about valve timing that has changed on model locomotives, yet in full size timings once properly arranged only deteriorated through pin and bearing wear (or perhaps weary springing): big engines have return cranks and eccentrics located by keys and spindles are fixed in taper sockets. The golden rule for all valve gears is to make return cranks and eccentrics as accurately as possible using jigs to ensure that they are all the same, then fit them at

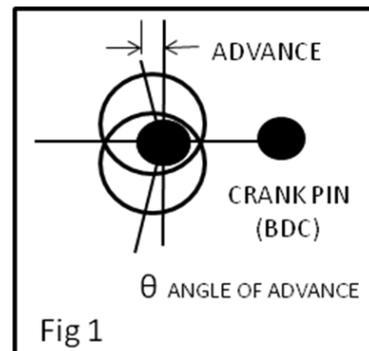


Fig 1

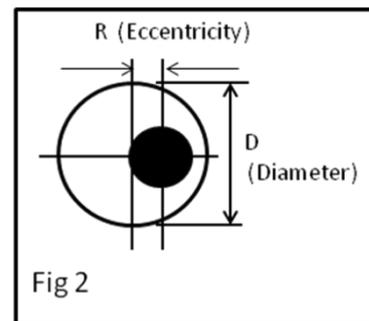


Fig 2

the correct angle, i.e. as per valve gear layout drawing, again using jig set-ups. Don't get me wrong when I mention jigs, I don't mean spending time and material making fancy bits to put into exhibitions, all we need are off cuts, clamps, screwed rod, the odd angle plate and a flat surface such as the drill or mill table. If the gear is set up as per design the only "setting" needed will be to adjust the valve on the spindle to get similar events at each end of the cylinder: I leave it to you to choose equal leads, equal openings or equal cut-offs.

Back to eccentrics: the usual Stephenson arrangement is drawn in Fig 1 where the traditional slide valves between the cylinders layout is shown with the crank at BDC, the forward eccentric is up and the backward one down and both are inclined forwards by the angle of advance θ . Fig 2 shows an eccentric, its diameter D is large enough to go round the axle and the axle centre is offset by a distance R the radius of eccentricity, neither dimension is in itself critical but whatever they are they must be the SAME for all eccentrics, or to tell the truth at least both eccentrics in a pair must be the same, variance between pairs is not critical. Let's assume that we are doing a 2-cylinder engine so we need 2 sets of valve gear each with a pair of eccentrics made of either steel or cast iron. Full size eccentric straps have a groove to fit a ridge on the eccentrics but models usually reverse the arrangement with plain straps fitting between cheeks on the eccentric, I certainly find the model method easier to deal with and I omitted the inner cheeks of each eccentric pair leaving just the outside ones to prevent the straps slipping off. So, we start with 2 blanks, one for each pair, the diameter equal to that of the cheeks and long enough for 2 single-cheek eccentrics plus parting off allowance. Turn down the eccentric

diameter on each end of both blanks to just over finished size, finally finishing all 4 eccentrics without moving the setting of the lathe tool so all D's are the same. This is useful for avoiding making straps to different sizes and critical to the setting procedure. Blanks are then transferred to the 4-jaw chuck and offset by the eccentric radius R, either use a DTI or wind in a bar on the cross slide to measure the total run-out (= 2R), within a few thou is fine since we are doing a pair at the same setting and both eccentrics will therefore turn out exactly the same. After boring and reaming to axle diameter mark each eccentric pair before separating and facing to thickness. So now we have 4 wobbly things identified as pairs, each member of a pair to same diameter and eccentricity.

Now we move on to setting the eccentrics at the correct angular position on the axle and FIXING them for good. The trick is to break things down into easy steps: first fix the angle between eccentrics in a pair and then set the pair at the correct angle on the axle. As an example, suppose that the eccentricity is 0.375" and the angle of advance is 15°, as each eccentric comes forward by this angle, they are no longer exactly opposite one another (180°) but at 150° (i.e. $180 - 2 \times 15$). As can be seen in Fig 1 the eccentrics move away from the 180° position by a distance equal to the advance, i.e. $R \times \text{sine}(\text{Advance angle})$ or in the example, $0.375 \times \sin 15^\circ = 0.097$ ".

This is easy to set up, just bolt a short stub axle offcut to an angle plate, set its centre at a distance half the diameter of the eccentrics will be opposite each other when on the stub and resting on the surface (Fig 3). Now machine a packing piece to 0.097" thickness and introduce it between the surface and the eccentrics, this makes them advance to the 15° position. If the outer end of the stub axle is tapped some convenient size the eccentrics can be clamped together using a bolt and washer so that they do not move while the angle plate is put under a drill and a locating hole put through both eccentrics. They are finally fixed together using a silver steel pin and Loctite. The last setting job is to fix the eccentric pairs to the crankshaft. In nearly all cases the centre line of the link motion is in the same plane as the motion so the crank can be set up horizontal on a surface and a square used across the eccentric assembly to set it at right angles to the crank (Fig 4), if the centrelines are not in the same plane a spacer is machined to put under the crankpin so as to rotate the crank by the required angle of inclination. Test the set up "dry" then put a spot of Loctite under the eccentrics. So far, the fixing is not final as Loctite can be freed with heat, so leave everything for a couple of days then go back and cross check all the angles again. If OK now is the moment to pin the eccentrics to the axle. That's it, the wobbly things will ALWAYS wobble how you want.

