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“Valve Gear, chickens and eggs”

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It is not unusual to hear model builders talking about valve gears and settings, usually in a rather uncertain way, with an idea that some magical improvement in the performance of an engine would occur if only the valve gear could be sorted out. An example came my way not long ago from a friend who is building a 5" G Great Eastern Rly 4-6-0 "Claude Hamilton" (LNER B12), not the ME design called "Eastern Belle", but the real Macoy from Stratford Works drawings. He is a GER enthusiast (fancy that, there's one of them at least) and he wanted something close to scale. Luckily he was not sorting out something already made, but trying to avoid difficulties at the pencil and paper stage.

The prototype had two inside cylinders with short travel piston valves driven through rocking levers from Stephenson's Link Motion. In LNER days they were given improved cylinders with long travel valves along the lines Maunsell had used for rebuilding the SECR E-class to E1. The designer/builder of the B12 model was trying to draw up scale cylinders and valve gear of the LNER type and asked me which he should tackle first, this led me to looking at the approach to cylinder and valve gear design in 5" G. If a prototype has well designed cylinders with a bit of luck it will scale OK (keeping an eye out for over-scale fouls) but the best route by far is to design the miniature around cylinders more-or-less the right size with similar diameter and stroke taken from a proven published model. There is no question as to what comes first, in both the full sized and model worlds: always the cylinders, no chicken and egg stuff!

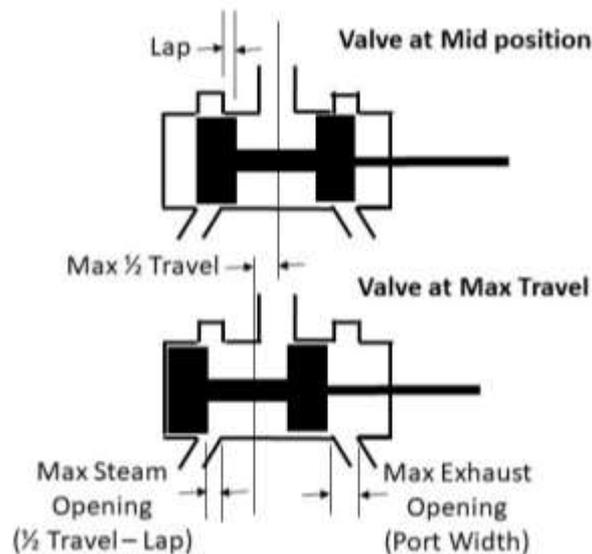
The cylinders and valves largely determine the performance of the locomotive and only when this matter has been decided can the valve gear be drawn up. Think of the valve gear as a slave that moves the valve according to our commands, however we cannot tell the slave what to do (i.e. design the VG) unless we know how the valve should move, and for this we need to have the complete cylinder and valve arrangement designed beforehand.

The rebuilding of the E class 4-4-0 at Ashford is a good example of the relationship between cylinders and valve gear. For any particular design of cylinder the actual type of valve gear can be whatever is most convenient, or more favoured by the designer. What it must do is to provide the valve travel needed for the designed port openings with the specified lap plus the desired lead. In other words, draw up the cylinders and valves and specify maximum valve travel, lap and lead. The E class were modernised by replacing the original 19th century cylinders with new ones of a similar size that were essentially the same as those already in use on the N Class 2-6-0 but adapted for locating inside the frames. This type of cylinder & valve driven by outside Walschaert's gear worked very well on the moguls and equally well when employed on the 4-4-0s using Stephenson link motion. Mark you, it was not exactly the same as fitted to the original engines as it was given a relatively simple modification to obtain the increased valve travel of the new cylinders. The valves above the cylinders in the original layout on the E class were driven through rocking levers so the increased travel was obtained by lengthening the upper part of the rocker, and the

movement for lap and lead adjusted by resetting the eccentrics; fortunately not too expensive and within the SECR's limited budget.

The actual valve gear was immaterial as long as it provided the correct movement. Going a little deeper into this it should be remembered that Maunsell had based the cylinders of the N Class (and several others afterwards) on those used by the GWR for their 4300 class 2-6-0s on which of course the valve gear was Churchward's variant of Stephenson's. The Ashford cylinders went on to do great things after being "exported" to Derby, first for the LMS 2-6-4Ts then on to the Scots, Baby Scots, etc being steadily improved along the way and ending up on the BR Standards.

In our scales the design of the valve gear is not usually a factor that prevents an engine from working, but rather it makes the difference between smooth running "notched up" with several turns taken off the reversing wheel versus flogging along in full gear with a lot of noise from the chimney. If we considered a particular valve gear "good" what would we mean? The answer is not really complicated: it provides the valve full-gear travel and lap movement needed for the cylinders being used with events (port openings, % cut-off, % release) that are not too different between each end of the cylinder (the outgoing and incoming strokes of the piston), and remain so throughout the working range of cut-off. It is very often this equality of events that occupies the minds of the designers and there are various tricks employed such as changing the suspension points of links and rods so as to even things out.



On the other hand, if we look at a class of engines that performed rather poorly for reasons not associated with steaming problems, we find glaring gaffs in the cylinders, ports and passages rather than some detail of valve gear. Even when we attribute deficiency to "short valve travel" it is of course the design of the valves that we are criticising and not the valve gear that operates them that way. Short travel valves (i.e. with small laps) are not necessarily always a bad thing although long travel is intrinsically better. There are many engines whose work was not suited to running extensively at early cut-offs such as heavy goods (low speed), short runs, shunting and empty working, so any operating benefit that might have been gained would be small. While Swindon was turning out large engines with excellent valve gear it was content to stick with the original Armstrong version of Stephenson's gear on hundreds of 0-6-0s.

Of course, there are instances of models with valve gear defects that seriously affect their performance and usually it is due to incorrect assembly of the gear rather than a wrong design: something has shifted or been reassembled incorrectly. This is more or less confined to the positions of eccentrics and return cranks or possibly the fixing of the valve to its spindle. In hindsight they should have been set and then pinned but we can't turn the clock back and there is no magic formula, so we have no alternative to the laborious job of trying different settings and observing what happens to the valve movement until we get it right.