

The David Wardale Proposal

In possibly the most interesting article that I have read in Steam Railway for a number of years, David Wardale's proposal for a high speed 4-6-0 locomotive is a bold attempt to move our hobby into the present century. I am sure that David expected his proposal to generate some controversy, and having had the courage to "put his head above the parapet" will be prepared for some criticism.

My first comment relates to the starting point of David's work, the BR5 4-6-0. I would not have begun the journey there! If I was asked to put together a proposal for a modern high speed 4-6-0 locomotive, the basis would not have been a successful mixed traffic design, but rather a proven express locomotive.

What was the best UK express 4-6-0? We are on controversial ground here. As an LNER fan, I have to concede that that railway has nothing to offer, while the SR Lord Nelsons were always a bit iffy. The GWR 4 cylinder locomotives were well ahead of their time when introduced, but the accolade has got to go the final derivative of the LMS Scot class. This was a robust 3 cylinder design, offering high specific power output, and demonstrating during the 1948 exchanges that it could compete with the larger pacifics in terms of train haulage at speed. I would base my design on the key parameters of the rebuilt Scot, giving me a larger boiler, bigger wheels, and three cylinders.

David does debate the relative advantages of two and three cylinder locomotives, but I believe that he has reached the wrong decision in choosing the two-cylinder machine. The two cylinder engine is intrinsically unbalanced, while the three cylinder, if properly configured, can have no external reciprocating imbalance. It is possible to trade reciprocating against rotational balance but you are creating another problem while only partially solving the first. There is no magic formula to get around the laws of motion, nothing has happened to change Newton's laws during the last 50 years, at least as far as the steam locomotive is concerned!

The reciprocating parts of the three cylinder engine are smaller, so the internal gas and inertia forces are lower. These factors contribute to a smoother, safer, more reliable, high speed locomotive.

David accepts that this will be a problem, and suggests that the reciprocating masses would have to be reduced from the 826 lb of the class 5, to 550 lb. Now given that the BR5 used the elegant light weight LNER type crosshead arrangement, I don't know how these savings will be made, particularly as the locomotive will be operating at a considerably higher boiler pressure.

Three cylinders do have additional benefits. The locomotive has a lower ratio of peak to mean torque than a two cylinder machine making it less likely to slip, while the more even blast on the fire should mean better combustion. On the negative side it will be more expensive to build and more difficult to maintain, but these are prices worth paying in a high speed locomotive.

Two cylinders was the correct choice for a 1950's mixed traffic locomotive, but there is no way I would specify a two cylinder 4-6-0 for use at speeds in excess of 100 mph!

Moving on to another thorny issue, why has David chosen to use Walschaerts valve gear rather than one of the more modern poppet valve alternatives? Conventional gear links the operation of inlet and exhaust ports in a sub optimal way, while poppet valve gear enables the two events to be independently controlled.

While the Caprotti solution allows for efficient mechanical operation, electrical actuation would enable microprocessor control of the valve events, allowing the locomotive to operate at optimum efficiency over a wide range of conditions. Motorists will know that all modern cars have electronic engine control systems, while many readers will remember that electrically operated valve gear was successfully employed on a class of express Garratt locomotives between the wars.

Further the power required to operate poppet valve gear is considerably less than that needed to drive piston valves. Walschaerts gear is pretty to see and is reliable, but it really has no place on a 21st Century locomotive.

Finally, I have a concern over type approval. Will it be possible to obtain type approval for a new design, rather than one based upon historical drawings? In particular what safety case can be made for a high speed locomotive with a restricted forward view as is proposed? Would a modern steam locomotive not have to have a cab forward design?

To conclude, allow me to congratulate David on his proposal for a new locomotive, I feel that this is an exciting and worthwhile idea that deserves support. I do not agree with the detail of the concept however, it is right in many ways (4-6-0, large tender, etc.), but 2 cylinders? No way!

Yours faithfully,

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