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Boiler design, model and prototype

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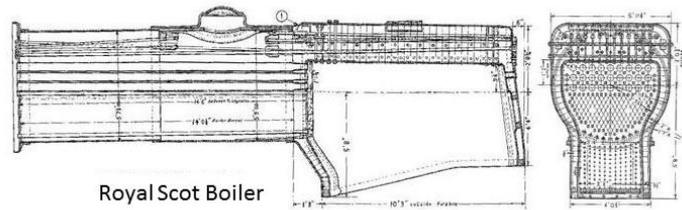
The boiler is one of the main considerations when building a steam locomotive, especially so for those people who venture away from the established published designs. It is one thing to draw up cylinders, frames and valve gear on the drawing board but quite another when it comes to boilers, unless the builder just happens to be qualified in pressure vessel design, which is rather unlikely. So, when deciding whether to build a model of a particular prototype I not only think about the availability of wheel and cylinder castings that could be adapted but also, I have to see if an existing design of model boiler can be used. Luckily a great number of boilers have been published in 5"G over the years so the trick is to have copies of lots of them and sort out something that will fit the bill. I have on file all the 3½"G and 5"G designs from ME over the last 40 years and a few from EIM, plus I have complete copies of Don Young's magazine and a few boiler sheets for other DYD models. If that doesn't work, I have been known to find out who has some old LBSC sheets and borrow them for a glance.

Boilers for narrow firebox engines fall into categories according to the type of barrel: parallel or taper, and type of firebox: round-top or Belpaire, so I have a look at models with the right combination and then try to find one with the required barrel diameter; at a pinch a bit under will do as the cleading can be padded out with more insulating material. Of course, the matter of length is also important, but the stress calculations are not affected by altering the barrel length neither are they for the firebox provided the number of stays is adjusted to maintain the design pitch. My Hunslet and Claughton boilers are both based on Don Young's "Pom-Pom" drawing, the Compound is the Belpaire version of LBSC's "Maid of Kent" and the Whitworth has Don's round-top "Lanky" boiler.

At the moment I am working on a 3½"G Royal Scot so I looked around for a 1/16 scale LMS Scot boiler. Unfortunately, the decline of this scale in recent years has led to fewer models being serialised in the magazines although there must be loads of them from half a century ago but I do not have access to the drawings. Don't even think about purchasing them on the off-chance; I recently enquired of ME the price of a particular sheet to be told they only supply the complete set for about £75. Wow, that's customer service for you! So I had a look through what I had got and knowing a bit about LMS boiler development I wondered if I could use the boiler from Martin Evans 3½"G "Euston 8F" design and turn it into a miniature Scot boiler by turning the clock backwards. To cut to the end of the story I could and I did, and it was quite fascinating to retrace the path that led to the LMS "Stanier" boilers.

In the early years of the LMS it was the old Midland tradition at Derby that prevailed so new locomotives were turned out using an existing MR standard or else another size was drawn up using established practices. There was a range of typical Belpaire boilers with parallel barrels all called "G" plus a number that denoted the outside length of the firebox in feet, the Compounds used G9AS and the largest was the G10S of the Lickey Banker. Overall, the designs were quite good so North British Locomotive Co had a sound basis on which to develop the even bigger boiler for the Royal Scot engines (which became G10¼ as its firebox was 10' 3" long) that were constructed as the LMS answer to the GWR who declined to supply them with Castles. The project was known as "Improved Castle" so it is not surprising that the firebox is just 3" longer with a grate just a whisker larger and the barrel diameter is very close to the large end of the Castle's taper, but there the similarity

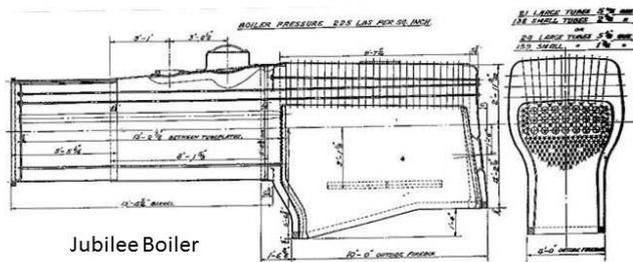
ends. As can be seen from the attached drawing the Scot has a parallel boiler and the firebox has a sloping throatplate that increases its volume and reduces the length of the tubes while it has 27 superheater flues against the 14 of the Castle. The ratios of tube sizes, free gas area, and proportion of flue area are very good so it is no surprise that it was an excellent steam raiser, which it had to be considering the horsepower the Scots were asked to put out on a daily basis. This boiler was followed by a slightly smaller one with a shorter firebox (G9½) designed at Crewe initially as a replacement Claughton boiler and then used for the “Baby Scots”. It was of a similar type but incorporated a few things that were standard at Crewe and it was equally successful with a reputation for good steaming.



At the time of the big change when Stanier arrived in 1932 it was evident that despite the managerial crises of the Locomotive Dept. the Company was not short of good boilers. The new man naturally brought with him those things that were considered as “best” at his previous place of employment, especially as he had spent his entire working life with the GWR and he had witnessed the transformation of design directed by Churchward 30 years before and closely adhered to thereafter. Stanier was a “works man” ideal for sorting out the organisational situation on the LMS but he was not, nor at Swindon had he needed to be, a design expert.

Stanier decided to introduce some GW ideas and simply provided his new team with copies of the relevant drawings. This was sufficient when dealing with axleboxes or wheels but boilers are far more complex. Just as the Baby Scot build programme was starting, he asked for all new locomotives to be fitted with taper boilers, but orders and work for parallel boilers were already in place for the first 50, so a new taper boiler based on the Castle type (No.8) was designed for the following engines. Had a copy of a No.8 been built and put on to the Baby Scots things would undoubtedly have been satisfactory, why not? But Derby took the design and subjected it to sundry small changes to suit their own practices and standard materials. Also, for some inexplicable reason they messed up the smokebox arrangements (correct on the Baby Scots). The engines would not steam as required which was, of course, rather embarrassing given the success of the originals.

Until then boiler design had been advanced by small steps with everything based on a previous satisfactory arrangement but there was a lack of understanding of the overall principles, and quite small changes in ratios have considerable effects on steaming. The years 1934-5 saw these boilers (designated 3A) subjected to all sorts of changes in an effort to solve the problem, including returning to the previous features of sloping throatplates (shorter tubes), regulators in domes (not smokebox) and 24 flue superheaters. As can be seen in the drawing, after all the modifications it was practically an LMS type boiler that had been given a taper barrel (weight saving), curved outer firebox sides (stress relief) and an increased space above the crown but retaining



many of the original LMS features. The Stanier Classes 5P5F and 8F followed soon after the Jubilees and they carried shortened versions of the same boiler called 3B & 3C, most of which were of the modified sloping throatplate type.

Martin Evans’ model 8F carries the sloping throatplate boiler so I reasoned that I could turn the clock backwards in 1/16 scale and re-engineer the miniature 3C into a Scot boiler

simply by giving it a parallel barrel and slightly longer flat sided firebox. Luckily the larger smokebox gives a bit more space to fit tubes and I was able to achieve a Free Gas Area ratio of almost 15%, not as good as the 17% of the big engine but satisfactory none the less. The tube surface to area (S/A) ratio of 125 is similar to that of other satisfactory boilers I have. So now it is just a question of waiting to see how it turns out when built; better than the original Jubilee boiler - I hope!