The Mysteries of the Smoke Box

One often hears the comment relating to why an engine won't steam well or it is difficult to maintain pressure, or I can't stop it blowing off or even I have difficulty maintain a good fire. Conversely there are those you claim it is dead easy to set up, they have no problem and the engine steams like a witch and works perfectly. Somewhere within these views there must be a logical answer to unlocking the mysteries of the Smoke Box. Running an engine that doesn't steam well is frustrating enough and this article may help to solve the problem. - Happy steaming.

Within this little box at the front end of the boiler there are a number of variables although some people are adamant there are none and it's all down to the 1:3 and 1:6 rule between the blast nozzle and the chimney as illustrated in the book "Model Steam Loco Construction" by Martin Evans page 18. Some appear to solve their problems by trial and error and on larger engines this probably is OK, but the smaller the scale a closer look is required. I believe there are several variables to consider leaving aside the central position of the blast up the chimney and ensure no air leaks around the smoke box door, the seal where the outlet and inlet pipes pass through the smoke box and the seal to the boiler. The question being what is the effect of the height of the blast nozzle, size of blast hole, the depth of the petticoat pipe protruding into the smoke box, the length of the chimney, whether a single or double chimney, level of the tubes in the boiler, restrictions caused by the super heater pipes and not forgetting the fire hole door vents which may be fitted to control the flow of air over the fire plus the effect of the drafting within the firebox and grate. All these variables having a contributing factor on the air flow and hence the effect on the fire to create steam in the boiler. Having looked and drawn to scale the actual dimensions given for various engines I conclude there are only a handful of models that really comply to the holy grail of the 1:3 and 1:6 rule used by LBSC and others.

So where to start and improve the performance of the engine. Perhaps a good point is checking the position of the blast nozzle to the petticoat pipe. Ideally, we want the exhaust steam to blast up the chimney with none escaping around the smoke box and reducing the vacuum. Usually, the designer of the engine has defined the depth the petticoat projects into the smoke box and it may have a flair end or just be a tube. More detailed engines may have a venturi design, but this article deals with the more common chimney arrangements.

The blast nozzle hole is fairly critical and should be 1/7th the diameter of the cylinder. Most plans will give you the drill size and the nozzle being made so it can be changed by unscrewing off the blast pipe. This is a good starting point and you may wish to make a couple additional nozzles to experiment with or refine your blast say by making the hole a drill size bigger and one smaller. The difference maybe only a few thou but it might just change the performance of the blast. Having made the nozzles, the next stage is to set the position of the nozzle in relation to the chimney / petticoat pipe. The hole in the blast nozzle should be parallel through its length to get a clear jet of steam as it leaves the nozzle. The entry end should be tapered to improve the flow up the blasting tube from the exhaust pipes.

Using a simple cardboard gauge with the diameter of the chimney being used as the reference point. The initial positioning of the blast nozzle in relation to the chimney can be set based on the 1:3 rule. Let's assume the diameter of the chimney is I inch, take a strip if card 1 inch wide and 6 to 8 inch long. At one end find the centre point i.e., 1/2 inch and at 3

inches from this end draw a line across the width of the strip. Next draw two lines from the 3 inch point to the centre point to make a V. The V replicates the shape of the steam leaving the blast nozzle. Cut out the shape and you have your 1:3 gauge. Pass the gauge down the chimney and with the point of the V fully inserted into the blast hole the line on the gauge should just align with the bottom of the chimney not the flanged section of the petticoat. This will give you a base adjustment. If the gauge shows the line is below the petticoat, then some of the steam from the blast nozzle will not go up the chimney but circulate around the smoke box. In effect prevent a good blast and reduce the vacuum within the smoke box. If the V is well up the chimney tube the effect of the blast will be weaker and not create a good blast. You can achieve the optimum position by adjusting the height if the blast nozzle which is usually below the centre line of the boiler or even lower. As long as the steam leaving the nozzle as indicated by the gauge actually goes up the chimney the blast will be right.

There is much comment on what's the best "blower" arrangement. Those who prefer the scale version to replicate the full-size engine opt for a ring around the blast nozzle with 3 or more small blast holes. These of course must be off set, so the blower output blast goes up the chimney. Unfortunately, this is not always the case and not all the steam goes up the chimney and some circulates around the smoke box and reduces the effect of the blower. The smoke box is a mucky place and the small blower holes can easily get blocked and need to be pricked out regularly. One of the common faults being when the holes are pricked out the dirt that was blocking the holes is pushed into the blower ring which eventually gets blasted back to block the holes. An alternative arrangement being to use a single nozzle on the end of the blower feed pipe and set it to point towards the centre of the chimney. This type of blast tends not to get blocked up and is easier to prick out rather than trying to find the smaller holes around the blast nozzle. Of course, the choice is yours, but experience tends to favour the single nozzle as the most reliable.

At the other end of the boiler there are a couple of key factors that affect the draughting. The grate arrangement with particular attention being given to the spacing and width of the bars. Again, the plans should give you the dimensions, but care should be taken as to the shape of the bars and many commercially supplied grates have a v section to support good sir flow. Much comment has been made on the "Rose" type grate which is a flat plate with loads of holes frilled in it and on one side countersunk to give a venturer effect. It is claimed these arrangements give a better airflow and the fire floats off the plate giving a good fire. The ash tends to be a powder giving rise that the combustion has been total. Again, the choice of grate is yours, but the aim is to maintain a good fire burning brightly rather than a dull semi black appearance.

The ash pan has an impact on the draughting as well and again there are several options to take from making adjustable flaps to just drilling holes in the pan to allow air flow or dare I suggest not even using an ash pan at all which I have witness over the years. The later being frowned upon as the ash just drops onto the sleeper - say no more. Care should be taken as to where the holes should be placed as if too close to the front of the fire box the air flow will result in the front of the fire glowing almost white hot and the rear with a black fire. The ideal is to achieve an air distribution to give a good overall fire. Too much blast / air concentration however can result in burnt our bars usually in the centre of the grate.

Last but perhaps often forgotten is the fire hole door arrangements and the vents to control the air across the fire. If the fire is burning fiercely, it is a fair assumption the blasting arrangements at the smoke box end are wrong. Leaving the door open only masks the problem and longer term you will experience a range of issues but that's another story

Finally, it is an obvious point but don't forget to ensure all the tubes are clear especially those housing the super heaters which tend to get block more readily but also get forgotten about when brushing out the tubes at the end of a run.

Driving a loco is all about balance between ensure there is adequate water in the boiler, watching the gauge glass checking the fire is bright and the coal level is maintained to using the regulator to produce just enough steam to maintain the engine and perform efficiently and match the output you require. A happy engine fully working results in a happy driver without any of the frustrations caused by those annoying smoke box issues.

HAPPY STEAMING