As a compliment to the 'How to' postings here's the start of some postings that hopefully will help us to understand how our live steam locos work.

In this posting Richard Hallam describes a fundamental requirement for our locos to operate.

HOW DOES IT WORK ...

Generating steam to do useful work.

To simplify the explanation the quoted units of pressure have been rounded up or down to use generally accepted standard definitions.

Firstly, for any given pressure of steam, there is a minimum temperature at which it can exist.

Because we exist in a pressurised environment, caused by the weight of atmosphere 15lbs pressure per square inch (psi) or 1 bar at sea level, heated water cannot produce steam until it exceeds a temperature of 100° C.

In other words water needs to be heated in excess of 100°C, representing 15 psi or 1 bar, to overcome the back pressure of the atmosphere before it can produce any useful work.

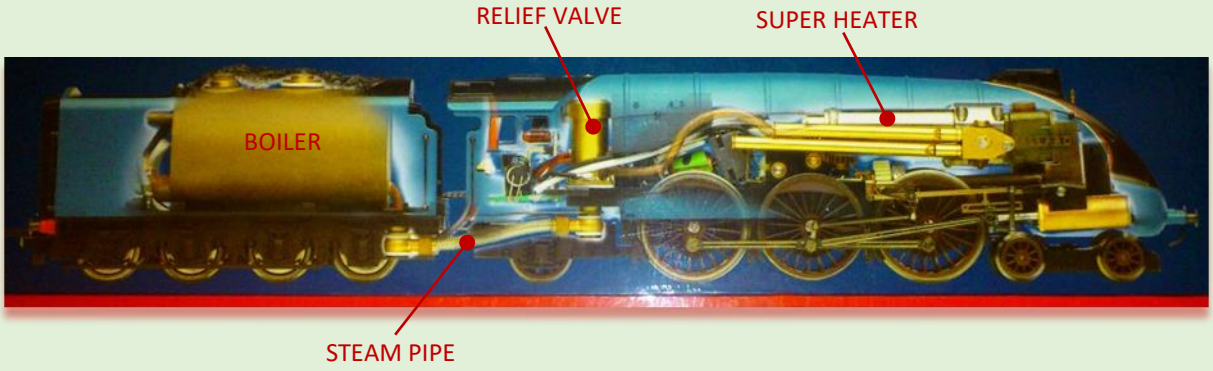
So what happens in our model boilers?

Maximum steam pressure is set via the safety valve, situated in the steam pipe leading to the super heater, at 30 psi (2 bar) requiring a minimum temperature of approximately 130°C.

Whilst the temperature is maintained at this level, and no steam allowed to escape, a balance will be established where existing steam at 30 psi (2 bar) will be trapped in the space above the water level but no additional steam generated.

In reality, heat will still have to be generated in the boiler to counteract heat lost through conduction. This would represent the ideal amount of heat required to keep a loco on permanent standby, allowance being made for additional energy consumed by the super heater element.

Any extra heat applied would cause a rise in pressure, activating the safety valve or, on opening the throttle, be absorbed in the cylinders hopefully doing useful work. I say 'hopefully' for a reason which I will deal with presently.



Steam pressure existing at its minimum temperature, as in a boiler, is known as 'saturated steam'.

If we were to apply saturated steam to the cylinders, significant heat would be lost on its journey, and pressure could only be maintained in the cylinders at a much lower level, seriously affecting the power of the loco.

The smaller the loco, the greater the effect due to heat loss being a greater factor. In the case of 00LS, all the steam would turn to water before it got to the cylinders - believe me I talk from experience!

However, the good news is that there is no upper limit to the temperature at which steam can exist at a given pressure. The solution therefore is to add temperature to the steam on its journey to the cylinders to counteract heat loss by conduction.

In fact there is an added bonus in adding even more heat, in that it expands the steam, using it more frugally and enabling our models to steam for 40 minutes or more. The effect on the boiler of this steam expansion is to reduce the steaming rate required and consequently water consumption.

Steam passing through the super heater on our models is heated to as much as 280°C, but cools to about 130°C on reaching the cylinders.

On larger models, and full size, drain cocks are provided on the cylinders to drain off condensed steam until the cylinders heat up sufficiently after starting.

On our tiny models, the super heater is designed to heat the whole cylinder block prior to starting, eliminating any condensation.

DO'S AND DON'TS ARISING FROM THE ABOVE

Always allow time for cylinder block to warm up. If you don't you will experience weak 'sloshy' running with much wet steam issuing from the chimney.
As a guide, the time it takes for a full boiler to come to full pressure is just about right.
Any notions of arranging things so that the super heater can be switched independently of the boiler allowing the super heater to be switched on later are not to be recommended.
Firstly the boiler element will be overloaded and secondly, a very watery start will be experienced. If it starts at all!

Continued …

If, during the warm up period, it is necessary to turn off the power for more than a few seconds having already heated the boiler to a point where you suspect pressure to be building up, it is best to let the boiler cool to or near zero pressure before switching back on.

The reason for this is that because of the mass of water in the boiler, this cools considerably slower than the super heater.
The result of switching on too soon will be that steam pressure in the boiler will build up faster than the super heater/regulator chest can amass enough heat to cope with it, resulting in a collapse of the steam pressure in this area and starting off a chain reaction of ever increasing condensation and a probable return to zero boiler pressure.

This will all be very noticeable as hot water oozes down the regulator shaft, meets atmospheric pressure and turns back to steam.